MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY

Course Curriculum
of
Bachelor of Science (B.Sc.) in Civil Engineering

DEPARTMENT OF CIVIL ENGINEERING

January 2024

Table of Contents

COMMITTEE FOR COURSE CURRICULUM REVIEW – CE DEPT, MIST

The undergraduate course curriculum of the Department of Civil Engineering (CE) of the Military Institute of Science and Technology (MIST) has been reviewed by the committee as mentioned below.

A. President

____

Brig Gen Kamal Uddin Komol, psc
Head, Department of Civil Engineering
Military Institute of Science and Technology

B. Internal Members

1. ____

Dr Md. Zoynul Abedin
Professor, Department of Civil Engineering
Military Institute of Science and Technology

2. ____

Brig Gen Shah Md Muniruzzaman (Rtd.), psc, PhD
Professor, Department of CivilEngineering
Military Institute of Science and Technology

3. ____

Dr. G. M. Jahid Hasan
Professor, Department of Civil Engineering
Military Institute of Science and Technology

4. ____

Dr. Md. Tauhid-Ur-Rahman
Professor, Department of Civil Engineering
Military Institute of Science and Technology

5. ____

Lt Col Khondaker Sakil Ahmed, PhD, PEng, Engrs
Instructor Class 'A', Department of Civil Engineering
Military Institute of Science and Technology

6. ____

Lt Col Mohammed Russedul Islam, PhD
Instructor Class 'A', Department of Civil Engineering
Military Institute of Science and Technology

7. ____

Lt Col Md Jahidul Islam, PhD, Engrs
Instructor Class 'A', Department of Civil Engineering
Military Institute of Science and Technology

C. <u>Members from Science and Humanities Department, MIST</u>

1. ____
   Lt Col Md Mahbubur Rahman Shah, PhD, AEC
   Instructor Class ‘A’, Department of Science & Humanities
   Military Institute of Science and Technology

2. ____
   Lt Col Md Munir Hossain, Mphil, AEC
   Instructor Class ‘A’, Department of Science & Humanities
   Military Institute of Science and Technology

D. <u>Members from BUP</u>

1. ____
   Brig Gen Md Mustafa Kamal, SGP
   Dean, Faculty of Science and Technology
   Bangladesh University of Professionals

2. ____
   Brig Gen Md Mahbubur Rahman Siddiqui, ndc, afwc, psc, MPhil
   Inspector of College
   Bangladesh University of Professionals

E. External Members (Academia)

1. ____
   Dr. Raquib Ahsan
   Professor, Department of Civil Engineering
   Bangladesh University of Engineering and Technology

2. ____
   Md. Hadiuzzaman
   Professor, Department of Civil Engineering
   Bangladesh University of Engineering and Technology

F. External Member (Industry)

1. ____
   Dr. Md. Abdullah Al Mamun, PEng
   Additional Chief Engineer, Technical Services Wing
   Roads and Highways Department

CHAPTER 1

GENERAL INFORMATION

1.1 Introduction of MIST

The necessity of establishing a technical institute for the Bangladesh Armed Forces was felt in the late eighties. In the absence of such an institution, officers of Bangladesh Armed Forces had been graduating from Bangladesh University of Engineering and Technology (BUET), Bangladesh Institute of Technology (BIT), and other foreign institutions of science and technology. With a view to meet the increasing demand for the development and dissemination of engineering and technological knowledge, Bangladesh Armed Forces established the Military Institute of Science and Technology (MIST) that promises to provide facilities for higher technical education both for the officers of Bangladesh Armed Forces as well as for civil students from home and abroad. The motto of MIST is ―Technology for Advancement. Founded on 19 April 1998, MIST started its journey on 31 January 1999 by offering a four-year bachelor's degree in Civil Engineering. Bachelor's degree in Computer Science Engineering course started in 2001. Bachelor courses in Electrical, Electronics & Communication Engineering and Mechanical Engineering started its journey from 2003. Bachelor of Science program on Aeronautical Engineering (AE) and Naval Architecture and Marine Engineering (NAME) program were started from 2008-2009 and 2012-2013 respectively. Besides, four new departments started their academic session from 2014-2015 i.e. Nuclear Science & Engineering (NSE), Biomedical Engineering (BME), Architecture (Arch), and Environmental, Water Resources, and Coastal Engineering (EWCE).

Foreign students from Sri Lanka were admitted for the first time at MIST. Presently students from Maldives, Palestine, Nepal, and Gambia are also studying in different Engineering Programs. MIST envisages creating facilities for the military as well as civil students from home and abroad dedicated to pursue standard curriculum leading to Graduation Degree. As an Institution without any gender biasness, MIST is already on steady stride upholding its motto "Technology for Advancement". MIST remains committed to contributing to the wider spectrum of the national educational arena and play a significant role in the development of human resources and ardently pursuing its goal to grow into a "Centre of Excellence". MIST has well-equipped classrooms with multimedia and web cameras with internet facilities and laboratories with modern equipment. The medium of instruction for all engineering programs is English. All academic programs of MIST are affiliated with the Bangladesh University of Professionals (BUP) and have close cooperation with Bangladesh University of Engineering and Technology (BUET) and Dhaka University (DU).

1.2 Vision and Mission of MIST

Vision: To be a center of excellence for providing quality education in the field of science, engineering, and technology and conduct research to meet the national and global challenges.

Mission:

a. To provide comprehensive education and conduct research in diverse disciplines of science, engineering, technology, and engineering management.

b. To produce technologically advanced intellectual leaders and professionals with high moral and ethical values to meet the socio-economic development of Bangladesh and global needs.

c. To conduct collaborative research activities with national and international communities for continuous interaction with academicians and industry.

d. To provide consultancy, advisory, testing, and other related services to government, non-government, and autonomous organizations including personnel for widening practical knowledge and contributing to the sustainable development of the society.

1.3 Salient Features of MIST

a. Rigorous admission and selection process for the best possible screening interactive sessions in the classroom.
b. Qualified faculty members.
c. Regular guest lectures and educational visits.
d. Culture of timeliness, commitment, and uninterrupted curriculum.
e. Flexibility in choosing competent faculties through outsourcing.
f. Well-thought-out and continuous feedback and assessment system.
g. Effective teaching through the innovative method.
h. Industrial attachment for on job training.
i. Emphasis on code of conduct and dress code.
j. Focus to develop students as good humans with all possible attributes of a successful leader.
k. Tranquil, pollution-free and secure campus life.

1.4 Location

MIST is located at Mirpur Cantonment, northwest edge of the greater Dhaka city, a hub of knowledge for the armed forces. Mirpur Cantonment is a small, calm, and quiet education village and free from all possible pollution of city life. A garland like a lake with migratory birds, three sides with extended green fields in the summer and water bodies in the rainy season, whistling birds on the tree branches, and overall bounty of nature adds to the already existing splendid academic atmosphere. Other neighboring academic institutions are National Defense College (NDC) and Defense Services Command and Staff College (DSCSC) – two international standard education centers.

1.5 Faculties

1.5.1 Faculty of Civil Engineering (FCE):

- Civil Engineering (CE)
- Architecture (Arch)
- Environmental, Water Resouce and Coastal Engineering (EWCE)
- Petroleum and Mining Engineering (PME)

1.5.2 Faculty of Electrical and Computer Engineering (FECE):

- Computer Science and Engineering (CSE)
- Electrical, Electronic and Communication Engineering (EECE)

1.5.3 Faculty of Mechanical Engineering (FME):

- Mechanical Engineering (ME)
- Aeronautical Engineering (AE)
- Naval Architecture and Marine Engineering (NAME)
- Industrial and Production Engineering (IPE)

1.5.4 Faculty of Science and Engineering (FSE):

- Biomedical Engineering (BME)
- Nuclear Science and Engineering (NSE)
- Department of Science (Mathematics, Physics, Chemistry) and Humanities

Presently MIST has 12 (twelve) departments to conduct B Sc. Engineering program under 04 (four) different engineering faculties. The departments impart education basing on common objectives and outcomes set by MIST and have defined program objectives and outcomes, specific to the departments respectively

1.6 Eligibility of Students for Admission in MIST (Subject to review each year)

The students must fulfill the following requirements:

a. **Bangladeshi Students.** Minimum qualifications to take part in the admission test are as follows:

(1) The applicant must have passed SSC / equivalent examination from Board of Intermediate and Secondary Education/Madrasa Education Board/Technical Education Board in Science Group obtaining GPA 4.00 (without a fourth subject) on a 5 points scale and in HSC/Equivalent examination from Board of Intermediate and Secondary Education/Madrasa Education Board/Technical Education Board in Science group the applicant must have obtained minimum GPA 4.00 on a 5 points scale. In HSC/Equivalent and SSC/Equivalent examination: (i) the applicant passed HSC or Equivalent in must obtain a

minimum total grade point 17 in four subjects (Mathematics, Physics, Chemistry, and English), (ii) SSC Examination (or Equivalent).

(2) The applicant must have qualified in minimum five subjects including Mathematics, Physics, Chemistry and English Language with minimum ‘B’ in average [i.e., A=5, B=4, C=3, D=2 & E=1, minimum required grade point=20] in GCE ‘O’ Level and in ‘A’ level/Equivalent background of Minimum ‘B’ grade in Mathematics, Physics and Chemistry.

(3) Applicants who have passed HSC or equivalent examination in the current previous year must grade obtain 19 in four subjects (Mathematics, Physics, Chemistry, and English).

(4) Sex: Male and Female.

b. **Foreign Students.** Maximum 3% of overall vacancies available will be kept reserved for the foreign students and will be offered to foreign countries through AFD of the Government of the People's Republic of Bangladesh. Applicants must fulfill the following requirements:

(1) Educational qualifications as applicable for Bangladeshi students or equivalent.

(2) Must have security clearance from respective Embassy/High Commission in Bangladesh.

(3) Sex: Male and Female.

In the event of non-availability of foreign students, Bangladeshi civil candidates will fill up the vacancies.

1.7 Number of Seats (Subject to review each year)

The highest number of seats for 04 (Four) years Bachelor Degree in Engineering programmes (Unit – A) and 5 (Five) years Bachelor Degree of Architecture programme are as follows:

Allocation of Seats

Ser	Unit	Department	Seats
1.	A	Civil Engineering (CE)	120
2.		Computer Science and Engineering (CSE)	120
3.		Electrical, Electronic & Communication Engineering (EECE)	120
4.		Mechanical Engineering (ME)	120
5.		Aeronautical Engineering (AE)	50

Ser	Unit	Department	Seats
6.		Naval Architecture and Marine Engineering (NAME)	40
7.		Biomedical Engineering (BME)	40
8.		Nuclear Science and Engineering (NSE)	40
9.		Environmental, Water Resource, and Coastal Engineering (EWCE)	60
10.		Industrial and Production Engineering (IPE)	50
11.		Petroleum and Mining Engineering (PME)	25
12.	**B**	Architecture (Arch)	25
	Total		810

1.8 Admission Procedure (Subject to review each year)

1.8.1 Syllabus for Admission Test. Admission test will be conducted on the basis of the syllabus of Mathematics, Physics, Chemistry and English (comprehension and functional) subjects of HSC examinations of all boards of secondary and higher secondary school certificates. There will be no multiple-choice type questions (MCQ). Admission test will be conducted out of 200 marks and the distribution of marks is given below:

Ser.	Subjects	Marks
1.	Mathematics	90
2.	Physics	70
3.	Chemistry	30
4.	English	10
		Total = 200

1.8.2 Final Selection. Students will be selected based on the results of the admission test. The individual choice for selection of departments will be given preference as far as possible. The minimum qualifying marks in the test is 40% for the applicants. In the case of a tie in the result of the admission test, the difference will be judged based on marks obtained in Mathematics, Physics, Chemistry, and English respectively in the admission test.

1.8.3 Medical Checkup. Civil candidates selected through the admission test will go for medical checkups in MIST medical center. If the medical authority considers any candidate unfit for study in MIST due to critical/contagious/mental diseases as shown in the medical policy of MIST will be declared unsuitable for admission.

1.9 Students Withdrawal Policy

1.9.1 General Policy of Withdrawal

The undergraduate (B.Sc.) Engineering programs for all engineering disciplines are planned for 04 regular levels, comprising of 08 regular terms and for Architecture programme it is planned for 05 regular levels, comprising of 10 regular terms. It is expected that all students will earn a degree by clearing all the offered courses in the stipulated time. In case of failure the following policies will be adopted:

a. Students failing in any course/subject will have to clear/pass the said course/subject by appearing in referred examination as per examination policy. In the case of students completing level-4, a maximum of three courses/subjects will be allowed in the referred examination (which is to be cleared within 6 years of registration).

b. The referred examination will be conducted at this institution before the commencement of the next level.

c. Maximum grading for supplementary/self-study examination etc. of failed subjects will be B+ as per examination policy.

d. One student can retake/reappear in a failed subject/course only twice. However, with the Permission of the Academic Council of MIST, a student may be allowed for the third time as the last chance.

e. In case of sickness, which leads to missing more than 40% of classes or miss term final examination (supported by requisite medical documents), students may be allowed to withdraw temporarily from that term and repeat the whole level with the regular level in the next academic session, subject to the approval of Academic Council, MIST. However, he/she has to complete the whole undergraduate program within 06 (six) academic years (for Architecture 07 academic years) from the date of his/her registration.

f. The minimum credit for the award of a bachelor’s degree in Engineering (BSc Engg) and Architecture (B Arch) will be decided by the respective department as per existing rules. However, the minimum CGPA requirement for obtaining a bachelor's degree in engineering and Architecture is 2.20.

g. Whatever may be the cases, students have to complete the whole undergraduate Program within 06 (six) academic years from the date of registration.

h. All other terms and conditions of the MIST Examination Policy remain valid.

1.9.2 Withdrawal on Disciplinary Ground

a. **Unfair Means**. Adoption of unfair means may result in expulsion of a student from the programme and expulsion so from the Institution. The Academic Council will authorize such expulsion on the basis of recommendation of the Disciplinary Committee, MIST and as per policy approved by the affiliating university. Following would be considered as unfair means adopted during examinations and other contexts:

i. Communicating with fellow students for obtaining help in the examination.

ii. Copying from another student's script/ report /paper.

iii. Copying from desk or palm of a hand or from other incrimination documents.

iv. Possession of any incriminating document whether used or not.

b. **Influencing Grades.** Academic Council may expel/withdraw any student for approaching directly or indirectly in any form to influence a teacher or MIST authority for grades.

c. **Other Indiscipline Behaviours.** Academic Council may withdraw/expel any student on disciplinary ground if any form of indiscipline or unruly behavior is seen in him/her which may disrupt the academic environment/programme or is considered detrimental to MIST's image.

d. **Immediate Action by the Disciplinary Committee of MIST.** The Disciplinary Committee, MIST may take immediate disciplinary action against any student of the Institution. In case of withdrawal/expulsion, the matter will be referred to the Academic Council, MIST for post-facto approval.

1.9.3 Withdrawal on Own Accord

a. **Permanent Withdrawal.** A student who has already completed some courses and has not performed satisfactorily may apply for a withdrawal.

b. **Temporary Withdrawal.** A student, if he/she applies, may be allowed to withdraw temporarily from the program, subject to approval of Academic Council of MIST, he will be allowed to apply fresh in future batch. If approved from the date of his/her registration.

CHAPTER 2

RULES AND REGULATIONS FOR UNDERGRADUATE PROGRAMME AT MIST

2.1 Introduction

MIST has introduced a course system for undergraduate studies from the academic session 2017-18. Therefore, the rules and regulations mentioned in this paper will be applicable to students for administering the undergraduate curriculum through the Course System. This will be introduced with an aim of creating a continuous, even, and consistent workload throughout the term for the students.

2.2 The Course System

The salient features of the Course System are as follows:

a. Number of theory courses will be generally 5 in each term. However, with the recommendation of the course coordinator and Head of the Department, Commandant MIST may allow relaxation in this regard. This relaxation is to be reported to the Academic Council of MIST.
b. Students will not face any level repeat for failing.
c. Students will get the scope to improve their grading.
d. Introduction of more optional courses to enable the students to select courses according to their individual needs and preferences.
e. Continuous evaluation of students' performance.
f. Promotion of student-teacher interaction and contact.

2.2.1 Besides the professional courses pertaining to each discipline, the undergraduate curriculum gives a strong emphasis on acquiring thorough knowledge in the basic sciences of mathematics, physics, and chemistry. Due importance is also given to the study of several subjects in humanities and social sciences.

2.2.2 The first two years of bachelor's degree programs generally consist of courses on basic engineering, general science, and humanities subjects; while the third and subsequent years focus on specific disciplines.

2.3 Number of Terms in a Year

There will be two terms (Spring Term I and Fall Term II) in an academic year.

2.4 Duration of Terms

The duration of each of Term I (Spring) and Term II (Fall) (maximum 22 weeks) may be as under:

Ser	Events	Durations
1.	Classes before Mid Term	7 weeks
2.	Mid Term Vacation	1 week
3.	Classes after Mid Term	7 weeks
4.	Makeup Classes and Preparatory leave	2~3 weeks
5.	Term Final Examination	2~3 weeks
6.	Term End Vacation	1~2 week

2.5 Course Pattern and Credit Structure

The first two years of bachelor's degree programs generally consist of courses on basic engineering, general science, and humanities subjects; while the third and subsequent years focus on specific disciplines.

2.6 Course Designation System

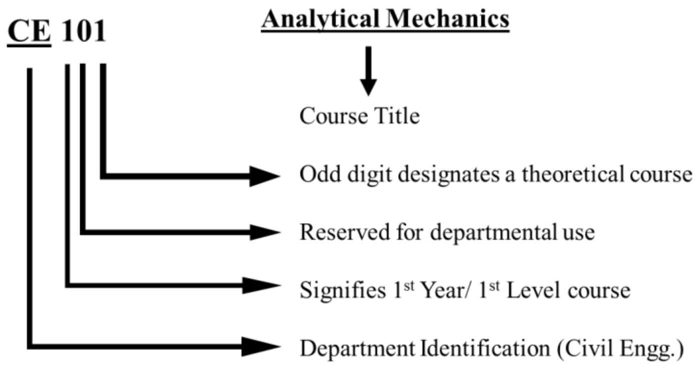
Each course is designated by a maximum of four-letter code identifying the department offering the course followed by a three-digit number having the following interpretation:

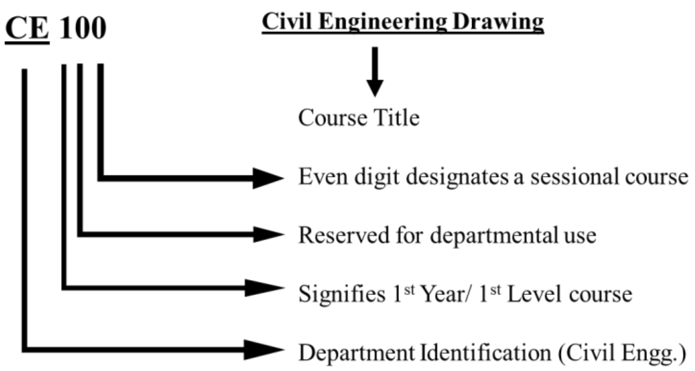
a. The left-most digit corresponds to the year/level in which the course is normally taken by the students. The second digit is reserved for departmental use. It usually identifies a specific area/group of study within the department.

b. The right-most digit is an odd number for theoretical courses and an even number for sessional courses.

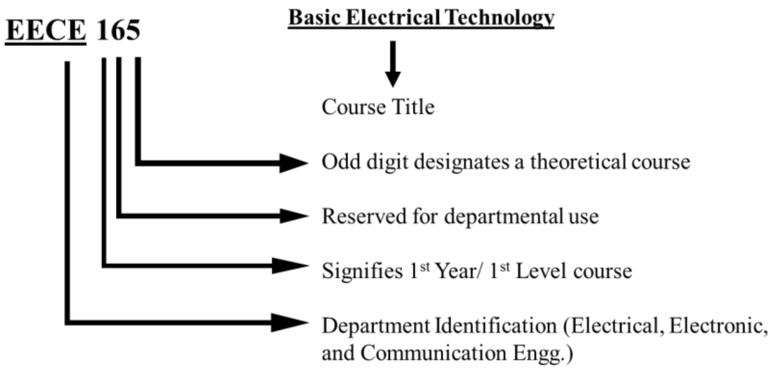
The course designation system is illustrated as Follows:

CE Dept. Courses

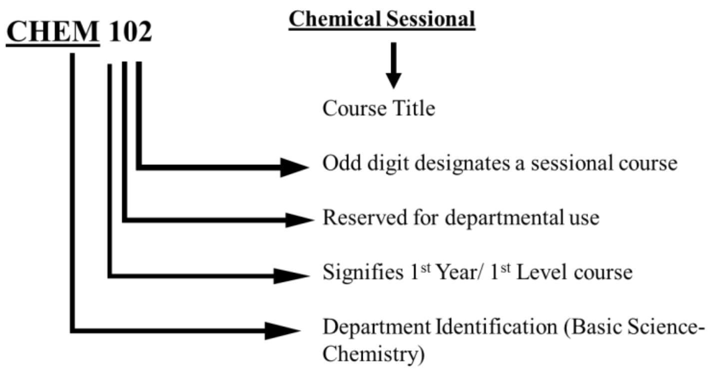




Interdisciplinary Course



Basic Science Course



2.7 Assignment of Credits

The assignment of credits to a theoretical course follows a different rule from that of a sessional course.

a. Theoretical Courses: One lecture per week per term is equivalent to one credit.

b. Sessional Courses: Credits for sessional courses is half of the class hours per week per term.

Credits are also assigned to project and thesis work taken by the students. The number of credits assigned to such work varies from one discipline to another.

2.8 Types of Courses

The types of courses included in the undergraduate curricula are divided into the following groups:

a. **Core Courses.** In each discipline, a number of courses are identified as core courses, which form the nucleus of the respective bachelor's degree program. A student has to complete the entire designated core courses of his/her discipline.

b. **Prerequisite Courses.** Some of the core courses are identified as prerequisite courses for a specific subject.

c. **Optional Courses.** Apart from the core courses, the students can choose from a set of optional courses. A required number of optional courses from a specified group have to be chosen.

2.9 Course Offering and Instruction

The courses to be offered in a particular term are announced and published in the Course Catalog along with the tentative Term Schedule before the end of the previous term. The courses to be offered in any term will be decided by Board of Undergraduate Studies (BUGS) of the respective department.

2.9.1 Each course is conducted by a course teacher who is responsible for maintaining the expected standard of the course and for the assessment of students' performance. Depending on the strength of registered students (i.e. on the number of students) enrolled for the course, the teacher concerned might have course associates and Teaching Assistants (TA) to aid in teaching and assessment.

2.10 Teacher Student Interaction

The new course system encourages students to come in close contact with the teachers. For promotion of a high level of teacher-student interaction, each student is assigned to an adviser and the student is free to discuss all academic matters with his/her adviser. Students are also encouraged to meet any time with other teachers for help and guidance in academic matters. However, students are not allowed to interact with teachers after the moderation of questions.

2.11 Students' Adviser

One adviser is normally appointed for a group of students by the BUGS of the concerned department. The adviser advises each student about the courses to be taken in each term by discussing the academic program of that particular term with the student.

2.11.1 However, it is also the student's responsibility to keep regular contact with his/her adviser who will review and eventually approve the student's specific plan of study and monitor the subsequent progress of the student.

2.11.2 For a student of second and subsequent terms, the number and nature of courses for which he/she can register is decided on the basis of academic performance during the previous term. The adviser may permit the student to drop one or more courses based on previous academic performance.

2.12 Course Registration

Any student who uses classroom, laboratory facilities or faculty-time is required to register formally. Upon admission to the MIST, students are assigned to advisers. These advisers guide the students in choosing and registering courses.

2.13 Registration Procedure

At the commencement of each term, each student has to register for courses in consultation with and under the guidance of his/her adviser. The date, time and venue of registration are announced in advance by the Registrar's Office. Counseling and advising are accomplished at this time. It is essential that all the students be present for registration at the specified time.

2.14 Pre-conditions for Registration

a. For first year students, department-wise enrollment/admission is mandatory prior to registration. At the beginning of the first term, an orientation program will be conducted for them where they are handed over with the registration package on submission of the enrolment slip.

b. Any student, other than the new batch, with outstanding dues to the MIST or a hall of residence is not permitted to register. Each student must clear their dues and obtain a clearance certificate, upon production of which, he/she will be given necessary Course Registration Forms to perform course registration.

c. A student is allowed to register in a particular course subject to the class capacity constraints and satisfaction of pre-requisite courses. However, even if a student fails in a pre-requisite course in any term, the concerned department (BUGS) may allow him/her to register for a course which depends upon the pre-requisite course provided that his/her attendance and performance in the continuous assessment of the mentioned pre-requisite course is found to be satisfactory.

2.15 Registration Deadline

Each student must register for the courses to be taken before the commencement of each term. Late registration is permitted only during the first week of classes. Late registration after this date will not be accepted unless the student submits a written application to the registrar through the concerned Head of the department explaining the reasons for delay. Acceptable reasons may be medical problems with supporting documents from the Medical Officer of MIST or some other academic commitments that prohibit enrollment prior to the last date of registration.

2.16 Penalty for Late Registration

Students who fail to register during the designated dates for registration are charged a late registration fee of Tk. 100.00 (One hundred only) per credit hours. Penalty for late registration will not be waived.

2.17 Limits on the Credit Hours to be Taken

2.17.1 A student should be enrolled for at least 15 credit hours and is allowed to take a maximum of 24 credit hours. Relaxation on minimum credit hours may be allowed. A student must enroll for the sessional courses prescribed in a particular term within the allowable credit hour limits.

2.17.2 In special cases where it is not possible to allot the minimum required 15 credit hours to a student, the concerned department (BUGS) may permit with the approval of the Comdt, a lesser number of credit hours to suit individual requirements. Only graduating students may be allowed to register less than 15 Cr Hr without the approval of the Commandant. A list of all such cases to be forwarded to Register Office, ICT dept, and Controller of Exam Office by the respective Department.

2.18 Course Add/Drop

2.18.1 A student has some limited options to add or drop courses from the registration list. The addition of courses is allowed only within the first two weeks of a regular. Dropping a course is permitted within the first four weeks of a regular term. Add or drop is not allowed after registration of courses for Supplementary-I and Supplementary-II Examination.

2.18.2 Any student willing to add or drop courses has to fill up a Course Adjustment Form. This also has to be done in consultation with and under the guidance of the student's respective adviser. The original copy of the Course Adjustment Form has to be submitted to the Registrar's Office, where the required numbers of photocopies are made for distribution to the concerned adviser, Head, Dean, Controller of Examinations and the student.

2.18.3 All changes must be approved by the adviser and the Head of the concerned department. The Course Adjustment Form has to be submitted after being signed by the concerned persons.

2.19 Withdrawal from a Term

If a student is unable to complete the Term Final Examination due to serious illness or serious accident, he/she may apply to the Head of the degree awarding department for total withdrawal from the term before commencement of term final examination. However, the application may be considered during the term final examination in a special case. The application must be supported by a medical certificate from the Medical Officer of MIST. The concerned student may opt for retaining the sessional courses of the term. The Academic Council will take the final decision about such applications. However, the total duration for graduation will not exceed 6 academic years.

2.20 The Grading System

The total performance of a student in a given course is based on a scheme of continuous assessment, for theory courses this continuous assessment is made through a set of quizzes, class tests, class evaluation, class participation, homework assignment, and a term final examination. The assessments for sessional courses are made by evaluating the performance of the student at work during the class, viva-voce during laboratory hours, and quizzes. Besides that, in the end, there will be a final lab test. Each course has a certain number of credits, which describes its corresponding weightage. A student's performance is measured by the number of credits completed satisfactorily and by the weighted average of the grade points earned. A minimum grade point average (GPA) is essential for satisfactory progress. A minimum number of earned credits also have to be acquired in order to qualify for the degree. Letter grades and corresponding grade points will be given as follows:

Numerical Markings	Grade	Grade Points
80% and above	A+	4.00
75% to 79%	A	3.75
70% to 74%	A-	3.50
65% to 69%	B+	3.25
60% to 64%	B	3.00

Numerical Markings	Grade	Grade Points
55% to 59%	B-	2.75
50% to 54%	C+	2.50
45% to 49%	C	2.25
40% to 44%	D	2.00
below 40%	F*	0.00
	AB	Absent
	DC	Dis-collegiate
	VW	Voluntary withdrawn
	X	Project/ Thesis Continuatiom
	E	Expelled
	S	Satisfactory

*Subject in which the student gets F grade shall not be regarded as earned credit hours for the calculation of Grade Point Average (GPA).

2.21 Marks Distrubtion

2.21.1 Theory. Forty percent (40%) marks of a theoretical course shall be allotted for continuous assessment, i.e. quizzes, home assignments, class tests, observations/ class participation, and class attendance. These marks must be submitted to the Office of the Controller of Examinations before the commencement of the final exam. The rest of the marks will be allotted to the Term Final Examination. The duration of the final examination will be three (03) hours. The scheme of continuous assessment that a particular teacher would follow for a course will be announced on the first day of the classes.

Distribution of marks for a given course per credit is as follows:

Sl.	Components	Grading
1	Class Performance	5%
2	Class Attendance	5%
3	Class Test / Assignment	20%
4	Mid Term Assessment (Exam / Project)	10%
5	Final Examination (Section A & B)	60%
	Total	**100%**

Note: Distribution of marks may change based on the decision of Academic Council of MIST.

2.21.2 Sessional/Practical Examinations

Sessional courses are designed and conducted by the concerned departments. Examination on sessional/practical subjects will be conducted by the respective department before the commencement of term final examination. The date of practical examination will be fixed by the respective department. Students will be evaluated in the sessional courses on the basis of the followings (all or as decided by the Examination Sub-Committee):

SL.	Components		Grading
1	**Continuous Assessment (60%)**	Class Performance	5%
		Conduct of Lab Test	20%
		Report Writing/Programming	15%
		Mid-term Evaluation (Exam/Project/Assignment)	20%
2	**Final Evaluation (40%)**	Final Exam (Exam/Project/Assignment)	30%
		Viva Voce/ Presentation	10%
	Total Marks		100%

Note: The above distribution of percentage is a general guideline. Department can rearrange to some extent if required

2.21.3 Sessional Course in English. The distribution will be as under:

Sl.	Components	Grading
1	Class Performance	5%
2	Class Observation	5%
3	Written Assignment	15%
4	Oral Performance	25%
5	Listening Skill	10%
6	Group Performance	30%
7	Viva Voce	10%
	Total	**100%**

2.21.4 Class Attendance.

Class attendance may be considered as a part of continuous assessment.

2.21.5 Collegiate and Non-collegiate

Students having class attendance of 85% or above in individual subject will be treated as collegiate and less than 85% and up to 70% will be treated as non-collegiate in that subject. The non-collegiate student(s) may be allowed to appear in the examination subject upon payment of non-collegiate fee/fine of an amount fixed by MIST/BUP. Students having class attendance below 70% will be treated as dis-collegiate and will not be allowed to appear in the examination and treated as fail. But in a special case such students may be allowed to appear in the examination with the permission of Commandant and it must be approved by the Academic Council.

2.22 Calculation of GPA

Grade Point Average (GPA) is the weighted average of the grade points obtained of all the courses passed/completed by a student. For example, if a student passes/completes *n* courses in a term having credits of $C_1, C_2, \dots, C_n$ and his grade points in these courses are $G_1, G_2, \dots, G_n$ respectively then

$$GPA = \frac{\sum_{i=1}^{n} CiGi}{\sum_{i=1}^{n} Ci}$$

The Cumulative Grade Point Average (CGPA) is the weighted average of the GPA obtained in all the terms passed/completed by a student. For example, if a student passes/ completes n terms having total credits of $TC_1, TC_2, \dots, TC_n$ and his GPA in these terms are GPA_1, GPA_2, GPA_n respectively then

$$CGPA = \frac{\sum_{i=1}^{n} TCiGPAi}{\sum_{i=1}^{n} TCi}$$

Numerical Example

Suppose a student has completed eight courses in a term and obtained the following grades:

Course	Credits, C_i	Grade	Grade, G_i	Points, C_I*G_i
CE 100	1.50	A	3.75	5.625
CE 101	3.00	A+	4.0	12.00
PHY 101	3.00	A-	3.50	10.50
CHEM 101	3.00	A+	4.00	12.00

Course	Credits, C_i	Grade	Grade, G_i	Points, C_I*G_i
MATH 101	3.00	B	3.00	9.00
GEBS 101	2.00	B-	2.75	5.50
CSE 176	1.50	B	3.00	4.50
ME 132	1.50	A+	4.00	6.00
CHEM 102	1.50	A	3.75	5.625
Total	20			70.75

GPA = 70.75/20.00 = 3.5375

Suppose a student has completed four terms and obtained the following GPA.

Level	Term	Credit Earned, TC_I	Hours GPA Earned, GPA_i	GPA_i*TC_i
1	1	20.00	3.73	74.60
1	2	20.00	3.93	78.60
2	1	20.00	3.96	79.20
2	2	20.00	4.00	80.00
Total		**80.00**		**312.40**

CGPA = 312.40/80 = 3.905

2.23 Minimum Earned Credit and GPA Requirement for Obtaining Degree

Minimum credit hour requirements for the award of Bachelor's degree in engineering (B.Sc. Engineering) and other discipline will be decided as per existing rules. The minimum CGPA requirement for obtaining a Bachelor's degree in engineering and other discipline is 2.20.

2.24 Minimum Earned Credit and GPA Requirement for Obtaining Degree (Additional Course)

Minimum credit hour requirements for the award of Bachelor's degree in engineering (B.Sc. Engineering) and other discipline will be decided by the respective department (BUGS). However, at least 157 credit hours for engineering must be earned to be eligible for graduation. This must include the specified core courses. The minimum GPA requirement for obtaining a Bachelor's degree in Engineering and Architecture is 2.20. A student may take additional courses with the consent of his Advisor in order to raise GPA, but he/she may take a maximum of 15 such additional credits beyond respective credit-hours requirements for Bachelor's degree during entire period of study.

2.25 Impacts of Grade Earned

The courses in which a student has earned a 'D' or a higher grade will be counted as credits earned by him/her. Any course in which a student has obtained an 'F' grade will not be counted towards his/her earned credits or GPA calculation. However, the 'F' grade will remain permanently on the Grade Sheet and the Transcript.

2.25.1 A student who obtains an 'F' grade in a core course will have to repeat that particular course. However, if a student gets an 'F' in an optional course, he/she may choose to repeat that course or take a substitute course if available. When a student will repeat a course in which he/she has previously obtained an 'F', he/she will not be eligible to get a grade better than 'B+' in that repeated course.

2.25.2 If a student obtains a grade lower than 'B+' in a particular course he/she will be allowed to repeat the course only once for the purpose of grade improvement. However, he/she will not be eligible to get a grade better than 'B+' for an improvement course.

2.25.3 A student will be permitted to repeat for grade improvement purposes a maximum of 6 courses in BSc. Engineering programs and a maximum of 7 courses in the B. Arch. program.

2.25.4 If a student obtains a 'B+' or a better grade in any course he/she will not be allowed to repeat the course for the purpose of grade improvement.

2.26 Classification of Students

At MIST, regular students are classified according to the number of credit hours completed/ earned towards a degree. The following classification applies to all the students:

Level	Credit Hours Earned	
	Engineering	Architecture
Level 1	0.0 to 36.0	0.0 to 34.0
Level 2	More than 36.0 to 72.0	More than 34.0 to 72.0
Level 3	More than 72.0 to 108.0	More than 72.0 to 110.0
Level 4	More than 108.0	More than 110.0 to 147.0
Level 5		More than 147.0

2.26.1 However, before the commencement of each term all students other than new batch are classified into three categories:

a. **Category 1:** This category consists of students who have passed all thecourses described for the term. A student belonging to this category will be eligible to register for all courses prescribed for the upcoming term.

b. **Category 2:** This category consists of students who have earned a minimum of 15 credits but do not belong to category 1. A student belonging to this category is advised to take at least one course less since he might have to register for one or more backlog courses as prescribed by his/her adviser.

c. **Category 3:** This category consists of students who have failed to earn the minimum required 15 credits in the previous term. A student belonging to this category is advised to take at least two courses less than a category 1 student subject to the constraint of registering at least 15 credits. However, he will also be required to register for backlog courses as prescribed by the adviser.

2.27 <u>Definition of Graduating Student</u>.

Graduating students are those students who will have ≤ 24 credit hours for completing the degree requirement.

2.28 <u>Performance Evaluation</u>

The performance of a student will be evaluated in terms of two indices, viz. Term Grade Point Average and Cumulative Grade Point Average which is the grade average for all the terms completed.

2.28.1 Students will be considered to be making normal progress toward a degree if their Cumulative Grade Point Average (CGPA) for all work attempted is 2.20 or higher. Students who regularly maintain a term GPA of 2.20 or better are making good progress toward the degrees and are in good standing with MIST. Students who fail to maintain this minimum rate of progress will not be in good standing. This can happen when any one of the following conditions exists:

a. The term GPA falls below 2.20.
b. The Cumulative Grade Point Average (CGPA) falls below 2.20.
c. The earned number of credits falls below 15 times the number of terms attended.

2.28.2 All such students can make up their deficiencies in GPA and credit requirements by completing courses in the subsequent term(s) and backlog courses, if there are any, with better grades. When the minimum GPA and credit requirements are achieved the student is again returned to good standing.

2.29 Application for Graduation and Award of Degree

A student who has fulfilled all the academic requirements for the Bachelor’s degree will have to apply to the Controller of Examinations through his/her Adviser for graduation. Provisional Degree will be awarded by BUP on completion of credit and GPA requirements.

2.30 Time Limits for Completion of Bachelor’s Degree

A student must complete his studies within a maximum period of six years for engineering and seven years for architecture.

2.31 Attendance, Conduct and Discipline

MIST has strict rules regarding the issues of attendance in class and discipline.

2.31.1 Attendance. All students are expected to attend classes regularly. The university believes that attendance is necessary for effective learning. The first responsibility of a student is to attend classes regularly and one is required to attend the classes as per MIST rules.

2.31.2 Conduct and Discipline. During their stay in MIST all students are required to abide by the existing rules, regulations and code of conduct. Students are strictly forbidden to form or be members of student organization or political party, club, society etc., other than those set up by MIST authority in order to enhance student’s physical, intellectual, moral and ethical development. Zero tolerance in regards of sexual abuse and harassment in any forms and drug abuse and addiction are strictly observed in the campus.

2.32 Teacher-Student Interaction

The academic system in MIST encourages students to come in close contact with the teachers. For promotion of high level of teacher-student’s interaction, a course coordinator (CC) is assigned to each course. Students are free to discuss with CC about all academic matters. Students are also encouraged to meet other teachers any time for help and guidance for academic matters. Heads of the departments, Director of Administration, Director of Students Welfare (DSW), Dean and Commandant address the students at some intervals. More so, monthly Commandant's Parade is organized in MIST where all faculty members, staff and students are formed up, thereby increasing teacher-student interaction.

2.33 Absence during a Term

A student should not be absent from quizzes, tests, etc. during the term. Such absence will naturally lead to reduction in points/marks, which count towards the final grade. Absence in the Term Final Examination will result in an F grade in the corresponding course. A student who has been absent for short periods, up to a maximum of three weeks due to illness, should approach the course teacher(s) or the course coordinator(s) for make-up quizzes or assignments immediately upon return to classes. Such request has to be supported by medical certificate from competent authority (e.g. CMH/MIST Medical Officer).

2.34 Recognition of Performance

As recognition of performance and ensure continued studies MIST awards medals, scholarships and stipends will be given as per existing rules and practices.

2.35 Types of Different Examinations (Subject to change for different academic session)

Following different types of final Examinations will be conducted in MIST to evaluate the students of Undergraduate Programs:

a. **Term Final Examination:** At the end of each normal term (after 22 wk or so), Term Final Examination will be held. Students will appear in the Term Final Examination for all the theory courses they have taken in the Term.

b. **Supplementary Examination:** It will take place twice in a year. Supplementary-I is defined as provision of giving exam in the first week of Spring Term (Jan-Jun) / Fall Term (Jul-Dec) end break and Supplementary-II in the first week of Fall Term (Jul-Dec) / Spring Term (Jan-Jun) end break, respectively. Students will be allowed to register for a maximum of two theory courses (Failed/Improvement) in Supplementary-I and maximum of one theory course (Failed/Improvement) in Supplementary-II.

c. **Improvement Examination:** It will be taken during Supplementary-I and Supplementary-II Examination. Questions will be same as the question of the regular examination of that Supplementary Examination (if any). Student can take maximum two subjects at a time (two subjects in supplementary-I and one subject in supplementary-II) and maximum 6 subjects in the whole academic duration. If a student obtains a grade lower than ‘B+’ in a course, he/she will be allowed to repeat the course only once for grade improvement. However, he/she will not be eligible to get a grade better then ‘B+’ for an improvement course. Among the previous result and improvement examination result, best one will be considered as final result for an individual student. However, performance of all examination i.e., previous to improvement examination, shall be reflected in thetranscript.

2.36 Rules of Different Examinations (Subject to change for different academic session)

2.36.1 Term Final Examination. Following rules to be followed:

a. Registration to be completed before commencement of the class. A student has to register his desired courses paying registration, examination fee and other related fees.

b. Late registration will be allowed without penalty within first one week of the term.

c. Within 1st two weeks of a term a student can Add/Drop course/courses. To add a course, in the 3rd week, one has to register the course by paying additional fees. To drop a course, one has to apply within three weeks and paid fees will be adjusted/ refunded. If anyone wants to drop a course after three weeks and within 4 weeks, that will be permitted but paid fees will not be refunded in that case.

d. Registrar office will finalize registration of all courses within 7 (seven) weeks, issue registration slip and that will be followed by issuing Admit Card.

e. Term Final Examination to be conducted in the 18-20th week of the term as per approved Academic Calendar.

2.36.2 Supplementary Examination. Following rules to be followed:

a. Supplementary-I is defined as provision of giving exam in the first week of Spring Term (Jan-Jun) / Fall Term (Jul-Dec) end break and Supplementary-II in the first week of Fall Term (Jul-Dec) / Spring Term (Jan-Jun) end break, respectively.

b. Students will be allowed to register for a maximum of two theory courses (Failed/Improvement) in Supplementary-I and maximum of one theory course (Failed/Improvement) in Supplementary-II.

c. No class will be conducted.

d. Forty percent (40%) marks will be considered from the previous exams.

e. Maximum grading in Supplementary Exam will be ‘B+’.

f. No Sessional Exam will be conducted.

g. Examination will be taken on 60% marks like Term Final Examination.

h. If a student fails in a course more than once in regular terms, then for calculating 40% marks best one of all continuous assessment marks will be counted.19

i. If anyone fails in the laboratory/sessional course, that course cannot be taken in the supplementary examination.

j. If any student fails in a course, he can clear the course retaking it 2nd time or, he can clear the examination appearing at the supplementary examination as any one fails twice in a course, can only retake it in the regular term for appearing third time. But anyone fails even after appearing third time. He/she has to take of Academic Council of MIST for appearing 4th (last) time in a course and need to pay extra financial penalty. If any student fails even 4th time in a course, will not be allowed to appear anymore in this same course.

k. Registration of Supplementary-I Exam to be done within 5th wk after completion of Fall Term (July to Dec) and registration of Supplementary-II exam to be done during the Mid-Term break of Spring Term (Jan to Jun), paying all the required fees.

l. There will be no provision for add/drop courses after registration.

m. Question Setting, Moderation, and Result Publication to be done following the same rules of Spring (Jan to Jun) / Fall (July to Dec) Term Final Exam as per existing Examination Policy.

n. Moderation of the questions for Supplementary-I will be done in the 5th week after completion of Fall Term (July to Dec) Final Exam and Supplementary II with the moderation of the questions of Spring Term (Jan to Jun).

o. Separate Tabulation sheet to be made.

p. Thesis: if a student cannot complete thesis in two consecutive terms, with the recommendation of the supervisor, he/she may continue for next one/two term within six academic years.

2.36.3 Improvement Examination.

The following rules are to be followed:

a. Improvement exam should be taken during the supplementary-I and supplementary-II examinations.

b. For Improvement examination, registration is to be done during the registration of supplementary-I and supplementary-II examinations by paying all the fees.

c. Question Setting, Moderation, and Result Publication to be done with courses of supplementary-I and supplementary-II examinations.

d. Any students get a grading below ‘B+’ and desires to improve that course, he will be allowed to appear the improvement examination for that particular course.

e. Highest garde of improvement examination will be ‘B+’

f. One student is allowed to appear at Improvement exam in 6 (six) courses in his whole graduation period taking maximum two courses at a time (two courses at supplementary-I and one course at supplementary-II).

2.37 Irregular Graduation

If any graduating student clears his/her failed course in Term-1 and his graduation requirements are fulfilled, his graduation will be effective from the result publication date of Term-1 and that student will be allowed to apply for provisional certificate.

CHAPTER 3

DEPARTMENT OF CIVIL ENGINEERING

3.1 Introduction to the Program

The CE Department of MIST, standing on the fourmoral attributes: fundamentals, innovation, excellence, and advancements, holds its glory of being the pioneer department of MIST. By creating a positive learning environment and sharing the most up-to-date technical knowledge and skills, the department of CE produces next-generation top-notch engineers and leaders for the nation. Since its commencement in 1999 with only 40 military students, this department has emerged to house and train engineering students at the undergraduate level at the current time. It is the first-ever department of MIST to receive accreditation from the Board of Accreditation for Engineering and Technical Education (BAETE) in 2008. In 2018, the department received the highest grade from BAETE during the re-accreditation process. Again in 2019 and 2023, the department received accredation under Outcome Based Education (OBE) following the guideline of BAETE and Washington Accord. This department has again pioneered the Post Graduate program by introducing the M.Sc. / M. Engg. and Ph.D. in 2012 and 2013 respectively. This department is enriched with highly experienced and disciplined teaching staff having a wide vision. At present, 36 faculties are serving in this department of whom 8 are Ph.D. qualified from home and abroad. This department highly promotes interactive learning and a collective class-environment which helps the students become more engrossed in employing themselves with the subject-matter and develop their depth of knowledge in engineering education. Besides, the programs emphasizing engineering science and design provides students with ample opportunity to put their knowledge into practice by solving real-world problems under the guidance of our readily approachable faculty members. This department also contributes to the country's infrastructural development. All-in-all, within a very short span of time, the CE department of MIST has spread its outreach throughout the nation and is playing a vital role in building an ingenious society enriched with engineering transcendence and revolution.

The proposed B. Sc. in Civil Engineering (CE) program comprises a total of 160 credits (201 contact hours) and 03 weeks of practical surveying and 03 weeks of internship. A student of this program can specialize in five (05) different disciplines, such as structural engineering, geotechnical engineering, water resource engineering, transportation engineering, and environmental engineering.

3.2 Vision and Mission of the Program

Vision:

To become a recognized leader in producing highly competent civil engineers by imparting quality education, promoting useful research and striving to induce social responsibilities, ethical values and leadership to enhance quality of life for people of the nation and the world.

Mission:

MD 1 To provide a high-quality learning environment for students in both undergraduate and postgraduate levels through a broad-based, rigorous curriculum, emphasizing theoretical and practical concepts to gain fundamental and specialized engineering knowledge, while they develop skills in critical thinking, communication, leadership, and lifelong learning.

MD 2 To create opportunities for students and faculty to conduct basic and applied research that contributes to society by advancing sustainable engineering principles and practices.

MD 3 To provide civil engineering leadership and service to the nation, the profession, and society at large with strong professional values, and disciplined work ethics.

3.3 Program Educational Objectives (PEOs)

No	PEO Statement
PEO-1	Graduates of Civil Engineering will develop a sound background in fundamental science and engineering principles as applied to civil engineering for a successful professional career.
PEO-2	Graduates of Civil Engineering acquire skills and abilities to excel in the area of civil engineering both in industries and academics.
PEO-3	Graduates of Civil Engineering will understand sustainable engineering practices, Socio-ethical values, and life-long learning.
PEO-4	Graduates of Civil Engineering possess awareness towards higher education, research & development and play a role to the leadership.

3.4 Program Outcomes (POs)

Program Outcomes (POs) represent the knowledge, skills, and attitudes the students should have at the end of a four-year engineering program. Based on the suggestion of the Board of Accreditation for Engineering and Technical Education (BAETE), Bangladesh, the Civil Engineering (CE) program has the following 12 Program Outcomes:

PO1 Engineering knowledge: Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialization (**WK1, WK2, WK3, WK4**) to the solution of complex Civil engineering problems.

PO2 Problem analysis: Able to identify, formulate, research literature and analyze complex Civil engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences (**WK1, WK2, WK3, WK4**).

PO3 Design/development of solutions: Able to design solutions for complex Civil engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental concerns **(WK5)**.

PO4 Investigation: Able to conduct investigations of complex Civil Engineering problems using research-based knowledge **(WK8)** and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

PO5 Modern tool usage: Able to create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modeling, to complex Civil engineering problems, with an understanding of their limitations **(WK6)**.

PO6 The engineer and society: Able to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex Civil engineering problems **(WK7)**.

PO7 Environment and sustainability: Able to understand and evaluate the sustainability and impact of professional engineering work in the solution of complex Civil engineering problems in societal and environmental contexts **(WK7)**.

PO8 Ethics: Able to apply ethical principles and commit to the professional ethics, responsibilities and the norms of the engineering practice **(WK7)**.

PO9 Individual work and teamwork: Able to function effectively as an individual, and as a member or leader of diverse teams and in multi-disciplinary settings.

PO10 Communication: Able to communicate effectively about complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports, design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project management and finance: Able to demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one’s work as a member or leader in a team, to manage projects and in multidisciplinary environments.

PO12 Life-long learning: Able to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

3.5 Bloom's Taxonomy

Bloom's Taxonomy is a classification system used to define and distinguish different levels of human cognition i.e., thinking, learning, and understanding. Typically, Bloom's Taxonomy is used to inform or guide the development of Assessments (tests and other evaluations of student learning), Curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies. There are three learning domains of Bloom's Taxonomy.

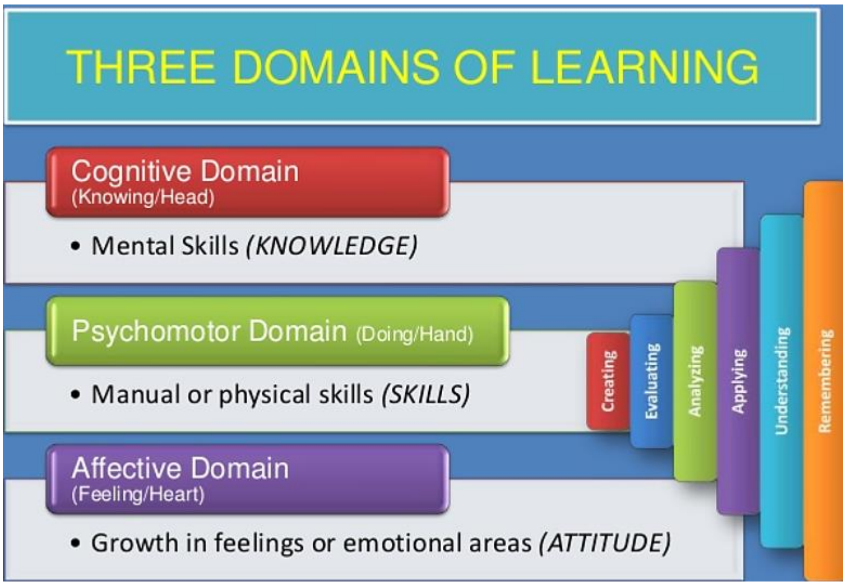


Figure 3.1: The Learning Domains of Bloom's Taxonomy (OBE Based Curriculam UGC 2020)

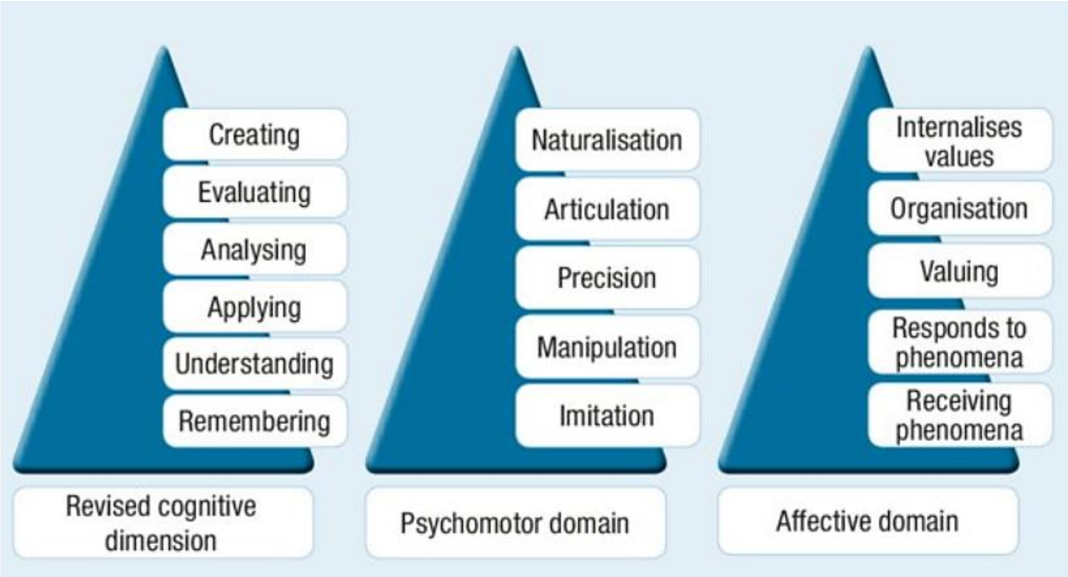


Figure 3.2: Three Domains of Bloom's Taxonomy (OBE Based Curriculam UGC 2020)

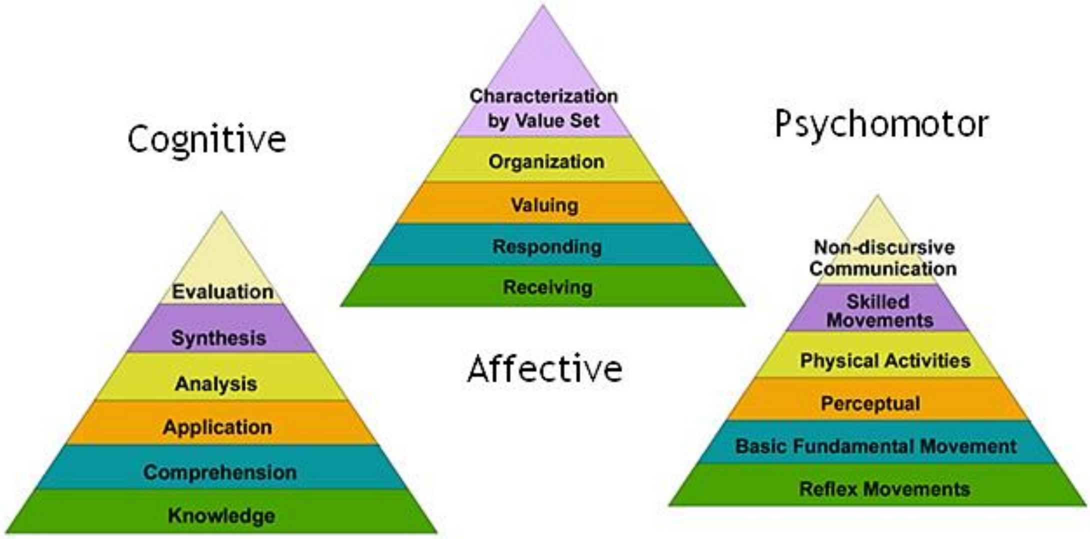


Figure 3.3: Levels of three Domains of Bloom's Taxonomy (OBE Based Curriculam UGC 2020)

3.6 Washington Accord

The graduate attributes adopted by the Washington Accord signatories are generic to the education of professional engineers in all engineering disciplines. They categorise what graduates should know, the skills they should demonstrate and the attitudes they should possess. The Washington Accord Graduate Attribute Profile has 12 elements, supported by a Knowledge Profile, WK1-WK8, and a definition of the Level of Problem Solving, WP1-WP7, which given below:

3.6.1 Knowledge Profiles (WK1 to WK8)

The Washington Accord Knowledge Profile has eight elements:

WK1: A systematic, theory-based understanding of the **natural sciences** applicable to the discipline.

WK2: Conceptually-based **mathematics**, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modeling applicable to the discipline.

WK3: A systematic, theory-based formulation of **engineering fundamentals** required in the engineering discipline.

WK4: Engineering **specialist knowledge** that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge that supports **engineering design** in a practice area.

WK6: Knowledge of **engineering practice** (technology) in the practice areas in the engineering discipline.

WK7: Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; the impacts of engineering activity: economic, social, cultural, environmental and sustainability.

WK8: Engagement with selected knowledge in the **research literature** of the discipline.

3.6.2 Range of Problem Solving

Complex Engineering Problems have characteristic WP1 and some or all of WP2 to WP7:

WP1 Depth of knowledge required: Cannot be resolved without in-depth engineering knowledge at the level of one or more of WK3, WK4, WK5, WK6 or WK8 which allows a fundamentals-based, first principles analytical approach.

WP2 Range of conflicting requirements: Involve wide-ranging or conflicting technical, engineering and other issues.

WP3 Depth of analysis required: Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models.

WP4 Familiarity of issues: Involve infrequently encountered issues.

WP5 Extent of applicable codes: Are outside problems encompassed by standards and codes of practice for professional engineering.

WP6 Extent of stakeholder involvement and conflicting requirements: Involve diverse groups of stakeholders with widely varying needs.

WP7 Interdependence: Are high level problems including many component parts or sub-problems.

3.6.3 Range of Engineering Activities

Complex activities mean activities or projects that have some or all of the following characteristics:

EA1 Range of resources: Involve the use of diverse resources (and for this purpose resources includes people, money, equipment, materials, information and technologies)

EA2 Level of interactions: Require resolution of significant problems arising from interactions between wide ranging or conflicting technical, engineering or other issues

EA3 Innovation: Involve creative use of engineering principles and research-based knowledge in novel ways

EA4 Consequences to society and the environment: Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation

EA5 Familiarity: Can extend beyond previous experiences by applying principles-based approaches.

3.7 Relationship/Mapping between Mission of the Dept and the Institute

No.	Mission statement of CE	Mission of MIST			
		Mission statement 1	Mission statement 2	Mission statement 3	Mission statement 4
1	Provide a high-quality learning environment for students in both undergraduate and postgraduate levels through a broad-based, rigorous curriculum, emphasizing theoretical and practical concepts to gain fundamental and specialized engineering knowledge, while they develop skills in critical thinking, communication, leadership and lifelong learning.	Yes	Yes	No	No
2	Create opportunities for students and faculty to conduct basic and applied research that contributes to society by advancing sustainable engineering principles and practices.	No	Yes	Yes	Yes

No.	Mission statement of CE	Mission of MIST			
		Mission statement 1	Mission statement 2	Mission statement 3	Mission statement 4
3	Provide civil engineering leadership and service to the nation, the profession and society at large with strong professional values, and disciplined work ethics.	No	Yes	Yes	No

3.8 Relationship/Mapping between PEO and Mission of the Dept

No.	Program Educational Objectives (PEOs)	Mission of CE Dept		
		Mission statement 1	Mission statement 2	Mission statement 3
1	Graduates of CE will develop a sound background in fundamental science and engineering principles as applied to civil engineering for a successful professional career.	Yes	No	Yes
2	Graduates of CE acquire skills and abilities to excel in the area of civil engineering both in industries and academics.	Yes	Yes	No
3	Graduates of CE will understand sustainable engineering practices, Socio-ethical values and life-long learning.	No	Yes	Yes
4	Graduates of CE possess awareness towards higher education, research & development and play a role to the leadership	Yes	Yes	No

3.9 Relation between PEOs and POs

No.	PO statement	PEO 1	PEO 2	PEO 3	PEO 4
1	**Engineering knowledge:** Apply the knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization (WK1, WK2, WK3, WK4) to the solution of complex Civil engineering problems	Yes	No	No	No
2	**Problem analysis:** Able to identify, formulate, research literature and analyze complex Civil engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences (WK1, WK2, WK3, WK4)	Yes	No	No	Yes
3	**Design/development of solutions:** Able to design solutions for complex Civil engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental concerns **(WK5)**.	Yes	No	No	No
4	**Investigation:** Able to conduct investigations of complex Civil Engineering problems using research-based knowledge **(WK8)** and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions	Yes	No	No	No
5	**Modern tool usage:** Able to create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modeling, to complex Civil engineering problems, with an understanding of their limitations **(WK6)**	Yes	Yes	No	No
6	**The engineer and society:** Able to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex Civil engineering problems **(WK7)**	No	No	Yes	No
7	**Environment and sustainability:** Able to understand and evaluate the sustainability and	No	No	Yes	No

No.	PO statement	PEO 1	PEO 2	PEO 3	PEO 4
	impact of professional engineering work in the solution of complex Civil engineering problems in societal and environmental contexts **(WK7)**				
8	**Ethics:** Able to apply ethical principles and commit to the professional ethics, responsibilities and the norms of the engineering practice **(WK7)**	No	No	Yes	No
9	**Individual work and teamwork:** Able to function effectively as an individual, and as a member or leader of diverse teams and in multi-disciplinary settings	No	No	No	Yes
10	**Communication:** Able to communicate effectively about complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports, design documentation, make effective presentations, and give and receive clear instructions	No	Yes	No	Yes
11	**Project management and finance:** Able to demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's work as a member or leader in a team, to manage projects and in multidisciplinary environments	No	No	Yes	No
12	**Life-long learning:** Able to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	No	No	Yes	Yes

3.10 Course Outcomes (COs):

The Course Outcomes (CO) are the resultant knowledge skills the student acquires at the end of a course. It defines the cognitive processes a course provides. Chapter 5 and 6 contain the detailed Learning Outcomes for each of the courses under the heading of Learning Outcomes (LOs).

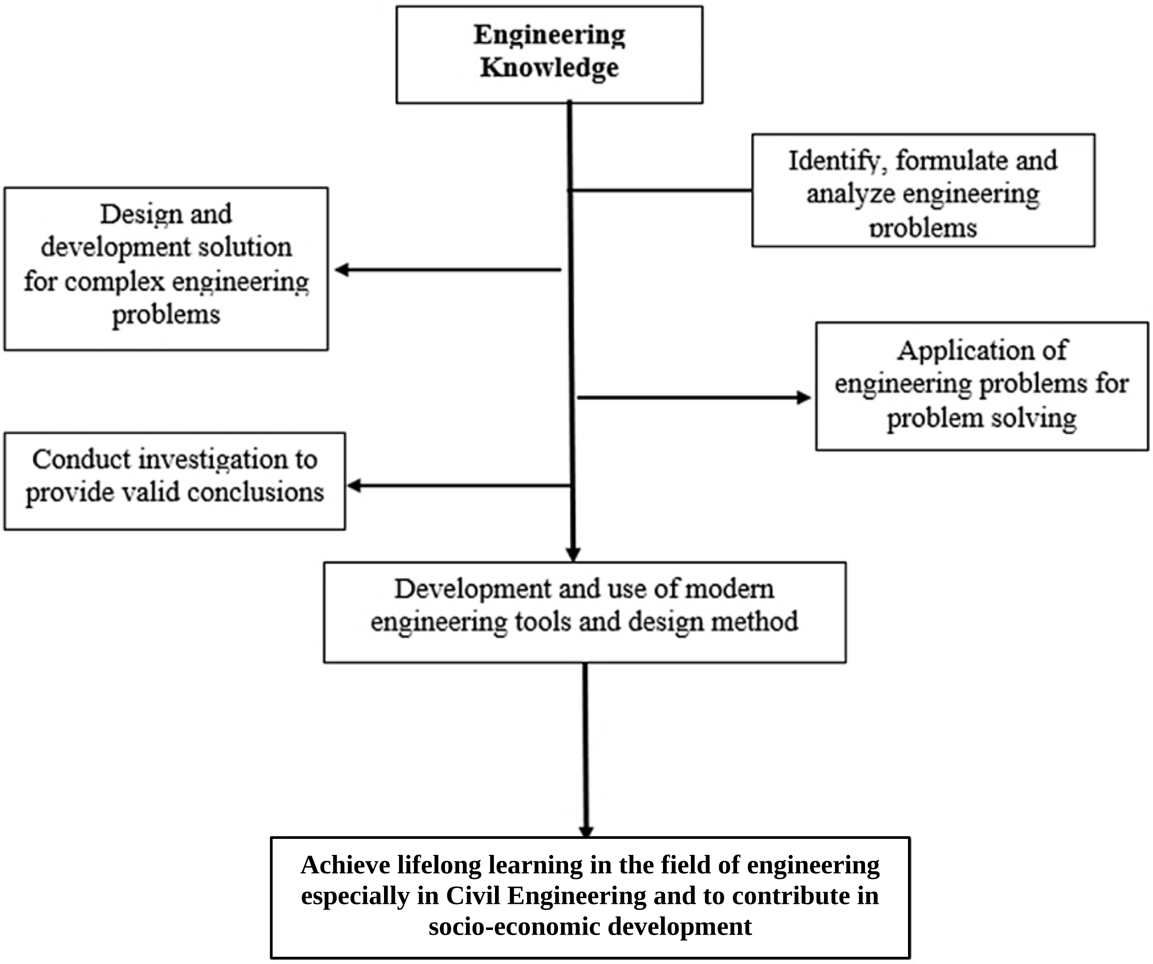
3.11 Generic Skills

The graduates of the NE program are expected to have the following generic skills:

a. Ability to apply the principles and theory of nuclear engineering knowledge to the requirements, design and development of different nuclear systems with appropriate understanding.
b. Ability to define and use appropriate research methods and modern engineering tools.
c. Ability to apply critical thinking to solve complex engineering problems and design innovative solutions.
d. Ability to learn independently, be self- aware and self- manage their time and workload.
e. Ability to analyze real time problems and justify the appropriate use of technology.
f. Ability to work effectively as an individual, and as a member or leader of a team in diverse situations and exhibit social responsibility.

3.12 Curriculum/ Skill Mapping

The courses of CE program are designed in such a way that the corresponding Course Outcomes (COs) contribute to the 12 Program Outcomes (POs) which eventually achieves the mission and vision of the program. Chapter 5 and 6 contain the mapping for each of the courses**.** However, generic curriculum/ skill mapping is shown below:


Engineering Knowledge
Identify, formulate and analyze engineering problems
Design and development solution for complex engineering problems
Application of engineering problems for problem solving
Conduct investigation to provide valid conclusions
Development and use of modern engineering tools and design method
Achieve lifelong learning in the field of engineering especially in Civil Engineering and to contribute in socio-economic development

CHAPTER 4

COURSE CURRICULUM FOR BACHELOR DEGREE IN CE

4.1 Introduction

Keeping the above-mentioned program outcome, the following courses are offered for the undergraduate students of Civil Engineering (CE) Program offered by the Department of Civil Engineering.

4.2 List of Language, General Education, Mathematics, Basic Science, and Interdisciplinary Courses

Basic Science

SL.	Course Code	Course Name	Level-Term	Cr. Hr.	Ct. Hr.
1	PHY 101	Waves and Oscillation, Optics, and Modern Physics	1-I	3	3
2	CHEM 101	Fundamentals of Chemistry	1-I	3	3
3	PHY 107	Structure of Matter, Heat and Temperature, Kinetics and Kinematics	1-II	3	3
4	CHEM 105	Environmental Chemistry	1-II	3	3
5	PHY 102	Physics Sessional	1-II	1.5	3
6	CHEM 102	Chemistry Sessional	1-I	1.5	3

Mathematics

SL.	Course Code	Course Name	Level-Term	Cr. Hr.	Ct. Hr.
1	MATH 101	Diffrential and Integral Calculus	1-I	3	3
2	MATH 103	Differential Equations and Matrix	1-II	3	3
3	MATH 201	Vector Analysis, Laplace Transform and Coordinate Geometry	2-I	3	3
4	MATH 203	Applied Mathematics for Engineers	2-II	3	3

General Education

SL.	Course Code	Course Name	Level-Term	Cr. Hr.	Ct. Hr.
1	GEBS 101	Bangladesh Studies	1-I	2	2
2	GES 101	Fundamentals of Sociology	1-I	2	2
3	GELM 175	Leadership and Management	1-II	2	2
4	GEA 201	Principles of Accounting	2-I	2	2
5	GEE 201	Fundamentals of Economics	2-I	2	2
6	GEEP 203	Engineering Ethics and Professional Practices	2-II	2	2
7	GERM 352	Fundamentals of Research Methodology	3-I	1	1
8	GESP 303	Sustainability of Development Projects	3-I	2	2
9	GEPM 401	Project Planing and Construction Management	4-II	3	3

Language

SL.	Course Code	Course Name	Level-Term	Cr. Hr.	Ct. Hr.
1	LANG 101	Language and Literature (বাংলা ভাষা ও সাহিত্য)	1-II	2.0	2.0
2	LANG 102	Communicative English I	1-II	1.5	3
3	LANG 202	Communicative English II	2-I	1.5	3

Interdisciplinary

SL.	Course Code	Course Name	Level-Term	Cr. Hr.	Ct. Hr.
1	CSE 176	Computer Programming Sessional	1-I	1.5	3
2	ME 132	Workshop Technology Sessional	1-I	1.5	3
3	EECE 165	Basic Electrical Technology	1-II	3	3
4	CSE 274	Engineering Computations Sessional	2-II	1.5	3

SL.	Course Code	Course Name	Level-Term	Cr. Hr.	Ct. Hr.
5	ARCH 214	Architechtural, Engineering and Planning Appreciation	2-II	1.5	3

4.3 List of Core Courses

SL.	Course Code	Course Name	Level-Term	Cr. Hr.	Ct. Hr.
1	CE 100	Civil Engineering Drawing	1-I	1.5	3
2	CE 101	Analytical Mechanics	1-I	3	3
3	CE 103	Surveying and Spatial Information Engineering	1-II	3	3
4	CE 102	Computer Aided Drawing	1-II	1.5	3
5	CE 104	Practical Surveying	1-II	1.5	3 weeks
6	CE 211	Mechanics of Solids I	2-I	3	3
7	CE 261	Fluid Mechanics	2-I	3	3
8	CE 203	Engineering Geology and Geomorphology	2-I	3	3
9	CE 200	Details of Construction	2-I	1.5	3
10	CE 210	GIS and Remote sensing	2-I	1.5	3
11	CE 262	Fluid Mechanics Sessional	2-I	1.5	3
12	CE 201	Engineering Materials	2-II	3	3
13	CE 205	Numerical Methods and Data Analysis	2-II	3	3
14	CE 213	Mechanics of Solids II	2-II	3	3
15	CE 208	Quantity Surveying	2-II	1.5	3
16	CE 212	Structural Mechanics and Materials Sessional	2-II	1.5	3
17	CE 311	Structural Analysis and Design I	3-I	4	4
18	CE 315	Design of Concrete Structures I	3-I	3	3

SL.	Course Code	Course Name	Level-Term	Cr. Hr.	Ct. Hr.
19	CE 331	Water Supply Engineering	3-I	3	3
20	CE 341	Principle of Soil Mechanics	3-I	4	4
21	CE 332	Environmental Engineering Sessional	3-I	1.5	3
22	CE 342	Geotechnical Engineering Sessional	3-I	1.5	3
23	CE 317	Design of Concrete Structures II	3-II	3	3
24	CE 333	Waste Water and Sanitation Engineering	3-I	4	4
25	CE 343	Foundation Engineering	3-II	3	3
26	CE 351	Fundamentals of Transportation Engineering	3-II	3	3
27	CE 361	Open Channel Hydraulics	3-II	3	3
28	CE 316	Concrete Structures Design Sessional I	3-II	1.5	3
29	CE 362	Open Channel Hydraulics Sessional	3-II	1.5	3
30	CE 300	Civil Engineering Students' Internship Programme (CESIP)	3-II	1.5	3 wks
31	CE 411	Structural Analysis and Design II	4-I	3	3
32	CE 413	Design of Steel Structures	4-I	3	3
33	CE 451	Highway Materials, Pavement Design and Railways	4-I	4	4
34	CE 463	Hydrology and Irrigation Engineering	4-I	4	4
35	CE 410	Concrete Structures Design Sessional II	4-I	1.5	3
36	CE 414	Steel Structures Design Sessional	4-I	1.5	3
37	CE 452	Highway Materials, Mix Design and Traffic Engineering Sessional	4-I	1.5	3
38	CE 400	Project and Thesis	4-I & II	4	8
39	CE 450	Capstone Project	4-I & II	3	6

4.4 List of Elective Courses

Structural Engineering

SL.	Course Code	Course Name	Level-Term	Cr. Hr.	Ct. Hr.
1	CE 412	Bridge Design Sessional	4-II	1.5	3
2	CE 415	Prestressed Concrete	4-II	2	2
3	CE 417	Design of Concrete Structures III	4-II	2	2
4	CE 419	Introduction to Finite Element Method	4-II	2	2
5	CE 421	Dynamics of Structures	4-II	2	2
6	CE 423	Structural Safety	4-II	2	2
7	CE 425	Seismic Design of Structures	4-II	2	2
8	CE 427	Advanced Solid Mechanics	4-II	2	2
9	CE 429	Design of Steel-Concrete Composite Structure	4-II	2	2

Environmental Engineering

SL.	Course Code	Course Name	Level-Term	Cr. Hr.	Ct. Hr.
1	CE 431	Natural Resources and Renewable Energy	4-II	2	2
2	CE 433	Solid and Hazardous Waste Management	4-II	2	2
3	CE 435	Environmental Pollution and Management	4-II	2	2
4	CE 437	Climate Change and Disaster Management	4-II	2	2
5	CE 439	Environmental Impact Assessment and Sustainability	4-II	2	2
6	CE 432	Design of Water Supply, Sanitation and Sewerage Systems	4-II	1.5	3

Geotechnical Engineering

SL.	Course Code	Course Name	Level-Term	Cr. Hr.	Ct. Hr.
1	CE 443	Earth Retaining Structures	4-II	2	2
2	CE 445	Elementary Soil Dynamics	4-II	2	2
3	CE 447	Soil-Water Interaction	4-II	2	2
4	CE 449	Numerical Methods in Geotechnics	4-II	2	2
5	CE 442	Foundation Design Sessional	4-II	1.5	3

Transportation Engineering

SL.	Course Code	Course Name	Level-Term	Cr. Hr.	Ct. Hr.
1	CE 453	Traffic Engineering Design and Management	4-II	**2**	**2**
2	CE 455	Pavement Management, Drainage and Airport Engineering	4-II	**2**	**2**
3	CE 457	Urban Transportation Planning & Management	4-II	**2**	**2**
4	CE 459	Intelligent Transportation System	4-II	**2**	**2**
5	CE 461	Railway Engineering	4-II	**2**	**2**
6	CE 454	Traffic Studies and Pavement Design Sessional	4-II	**1.5**	**3**

Water Resource Engineering

SL.	Course Code	Course Name	Level-Term	Cr. Hr.	Ct. Hr.
1	CE 465	Groundwater Engineering	4-II	2	2
2	CE 467	Flood Mitigation and Management	4-II	2	2
3	CE 469	River Engineering	4-II	2	2
4	CE 471	Hydraulic Structures	4-II	2	2

SL.	Course Code	Course Name	Level-Term	Cr. Hr.	Ct. Hr.
5	CE 473	Coastal Engineering	4-II	2	2
6	CE 472	Hydraulic Structures Design Sessional	4-II	1.5	3

4.5 Term Wise Distribution of Courses for B.Sc. Engg. in Civil Engineering (CE)

Level – 1, Term – I

SL.	Course Code	Course Name	Cr. Hr.	Ct. Hr.	Type
1	CE 101	Analytical Mechanics	3.0	3	T
2	PHY 101	Waves and Oscillation, Optics and Modern Physics	3.0	3	T
3	CHEM 101	Fundamentals of Chemistry	3.0	3	T
4	MATH 101	Differential and Integral Calculus	3.0	3	T
5	GEBS 101/ GES 101	Bangladesh Studies/ Fundamentals of Sociology	2.0	2	T
6	CE 100	Civil Engineering Drawing	1.5	3	S
7	CSE 176	Computer Programming Sessional	1.5	3	S
8	ME 132	Workshop Technology Sessional	1.5	3	S
9	CHEM 102	Chemistry Sessional	1.5	3	S
Total [Theory (T) – 5, Sessional (S) – 4]			20	26	

Level – 1, Term – II

SL.	Course Code	Course Name	Cr. Hr.	Ct. Hr.	Type
1	CE 103	Surveying and Spatial Information Engineering	3.0	3	T
2	EECE 165	Basic Electrical Technology	3.0	3	T
3	PHY 107/ CHEM 105	Structure of Matter, Heat and Temperature, Kinetics and Kinematics/ Environmental Chemistry	3.0	3	T

SL.	Course Code	Course Name	Cr. Hr.	Ct. Hr.	Type
4	MATH 103	Differential Equations and Matrix	3.0	3	T
5	GELM 175	Leadership and Management	2.0	2	T
6	CE 102	Computer Aided Drawing	1.5	3	S
7	PHY 102	Physics Sessoinal	1.5	3	S
8	LANG 102	Communicative English I	1.5	3	S
9	CE 104	Practical Surveying	1.5	3 wks	S
Total [Theory (T) – 5, Sessional (S) – 3, Survey]			20	23	

Level – 2, Term – I

SL.	Course Code	Course Name	Cr. Hr.	Ct. Hr.	Type
1	CE 211	Mechanics of Solids I	3.0	3	T
2	CE 261	Fluid Mechanics	3.0	3	T
3	CE 203	Engineering Geology and Geomorphology	3.0	3	T
4	MATH 201	Vector Analysis, Laplace Transform and Coordinate Geometry	3.0	3	T
5	GEA 201/ GEE 201	Principles of Accounting/ Fundamentals of Economics	2.0	2	T
6	CE 200	Details of Construction	1.5	3	S
7	CE 210	GIS and Remote Sensing	1.5	3	S
8	CE 262	Fluid Mechanics Sessional	1.5	3	S
9	LANG 202	Communicative English II	1.5	3	S
Total [Theory (T) – 5, Sessional (S) – 4]			20	26	

Level – 2, Term – II

SL.	Course Code	Course Name	Cr. Hr.	Ct. Hr.	Type
1	CE 201	Engineering Materials	3.0	3	T
2	CE 205	Numerical Methods and Data Analysis	3.0	3	T
3	CE 213	Mechanics of Solids II	3.0	3	T

SL.	Course Code	Course Name	Cr. Hr.	Ct. Hr.	Type
4	MATH 203	Applied Mathematics for Engineers	3.0	3	T
5	GEEP 203	Engineering Ethics and Professional Practices	2.0	2	T
6	CE 208	Quantity Surveying	1.5	3	S
7	CE 212	Structural Mechanics and Materials Sessional	1.5	3	S
8	CSE 274	Engineering Computations Sessional	1.5	3	S
9	ARCH 214	Architectural, Engineering and Planning Appreciation	1.5	3	S
Total [Theory (T) – 5, Sessional (S) – 4]			20	26	

Level – 3, Term – I

SL.	Course Code	Course Name	Cr. Hr.	Ct. Hr.	Type
1	CE 311	Structural Analysis and Design I	4.0	4	T
2	CE 315	Design of Concrete Structures I	3.0	3	T
3	CE 331	Water Supply Engineering	3.0	3	T
4	CE 341	Principles of Soil Mechanics	4.0	4	T
5	GESP 303	Sustainability of Development Projects	2.0	2	T
6	CE 332	Environmental Engineering Sessional	1.5	3	S
7	CE 342	Geotechnical Engineering Sessional	1.5	3	S
8	GERM 352	Fundamentals of Research Methodology	1.0	2	S
Total [Theory (T) – 5, Sessional (S) – 3]			20	24	

Level – 3, Term – II

SL.	Course Code	Course Name	Cr. Hr.	Ct. Hr.	Type
1	CE 317	Design of Concrete Structures II	3.0	3	T

SL.	Course Code	Course Name	Cr. Hr.	Ct. Hr.	Type
2	CE 333	Waste Water and Sanitation Engineering	4.0	4	T
3	CE 343	Foundation Engineering	3.0	3	T
4	CE 351	Fundamentals of Transportation Engineering	3.0	3	T
5	CE 361	Open Channel Hydraulics	3.0	3	T
6	CE 316	Concrete Structures Design Sessional I	1.5	3	S
7	CE 362	Open Channel Hydraulics Sessional	1.5	3	S
8	CE 300	Civil Engineering Students' Internship Programme (CESIP)	1.5	3 wks	-
Total [Theory (T) – 5, Sessional (S) – 2, CESIP]			20.5	22	

Level – 4, Term – I

SL.	Course Code	Course Name	Cr. Hr.	Ct. Hr.	Type
1	CE 411	Structural Analysis and Design II	3.0	3	T
2	CE 413	Design of Steel Structures	3.0	3	T
3	CE 451	Highway Materials, Pavement Design and Railways	4.0	4	T
4	CE 463	Hydrology and Irrigation Engineering	4.0	4	T
5	CE 410	Concrete Structures Design Sessional II	1.5	3	S
6	CE 414	Steel Structures Design Sessional	1.5	3	S
7	CE 452	Highway Materials, Mix Design and Traffic Engineering Sessional	1.5	3	S
8	CE 400	Project and Thesis	1.0	2	-
9	CE 450	Capstone Project	1.0	2	-
Total [Theory (T) – 4, Sessional (S)– 3, Project and Thesis, Capstone Project]			20.5	27	

Level – 4, Term – II

SL.	Course Code	Course Name	Cr. Hr.	Ct. Hr.	Type
1	CE 4XX	Two Theory Courses in Major Division from Elective Courses	4.0	4	T
2	CE 4XX	Two Theory Courses in Minor Division from Elective Courses	4.0	4	T
3	GEPM 401	Project Planning and Construction Management	3.0	3	T
4	CE 4XX	One Lab Course in Major Division from Elective Courses	1.5	3	S
5	CE 4XX	One Lab Course in Minor Division from Elective Courses	1.5	3	S
8	CE 400	Project and Thesis	3.0	6	-
9	CE 450	Capstone Project	2.0	4	-
Total [Theory (T) – 5, Sessional (S) – 2, Project and Thesis, Capstone Project]			19	27	

4.6 Summary of Credit Distribution - Level and Termwise

Level-Term	Contact Hours for Theory Courses	Contact Hours for Sessional Courses	Total Credit Hours	Total Contact Hours
1-I	14	12	20	26
1-II	14	9+3 wks (Survey)	20	23+3 wks (Survey)
2-I	14	12	20	26
2-II	14	12	20	26
3-I	16	8	20	24
3-II	16	6+3 wks (CESIP)	20.5	22 + 3 wks (CESIP)
4-I	14	9+2 hr. (Project and Thesis) + 2 hr. (Capstone Project)	20.5	23+2 hr. (Project and Thesis)+2 hr.

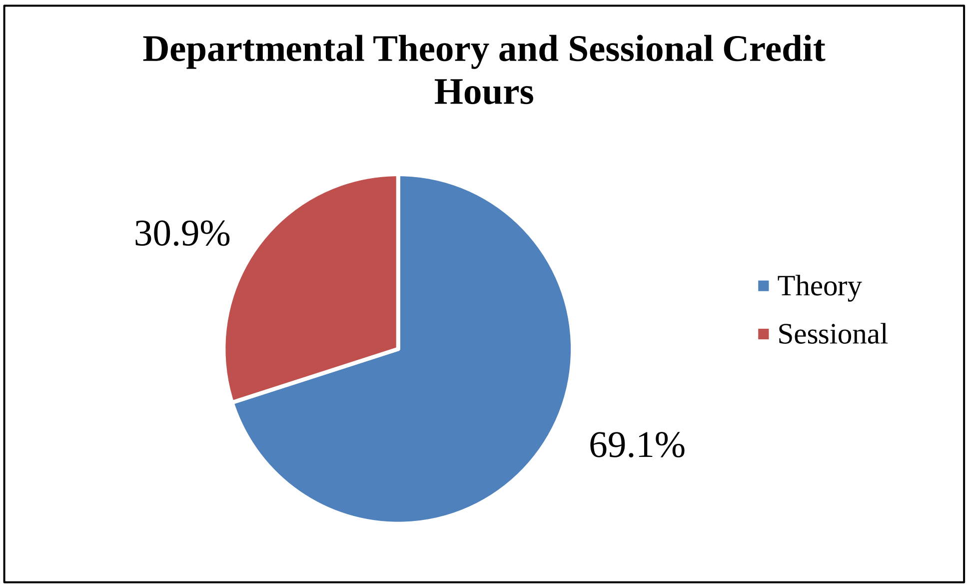
Level-Term	Contact Hours for Theory Courses	Contact Hours for Sessional Courses	Total Credit Hours	Total Contact Hours
				(Capstone Project)
4-II	11	6+6 hr. (Project and Thesis) + 4 hr. (Capstone Project)	19	17+6 hr. (Project and Thesis) + 4 hr. (Capstone Project)
Total	**113**	**87 + 6 wks**	**160**	**201 + 6 wks**

4.7 Summary of Theory and Sessional Courses- Level and Termwise

Level and Term	Contact Hours/Week			Credit Hours/Week			No. of Courses	
	Theory	Sessional	Total	Theory	Sessional	Total	Theory	Sessional
Level-1 Term-I	14	12	26	14	6	20	5	4
Level-1 Term-II	14	9+3 wks	23+3 wks	14	4.5+1.5 Survey	20	5	3+Survey
Level-2 Term-I	14	12	26	14	6	20	5	4
Level-2 Term-II	14	12	26	14	6	20	5	4
Level-3 Term-I	16	8	24	16	4	20	5	3
Level-3 Term-II	16	6+3 wks	22 + 3 wks	16	3+1.5 CESIP	20.5	5	2+CESIP
Level-4 Term-I	14	9+2 hr. (Project and Thesis) + 2 hr. (Capstone Project)	27	14	4.5+1 Project and Thesis + 1 Capstone Project	20.5	4	3+ Project and Thesis+ Capstone Project
Level-4 Term-II	11	6+6 hr. (Project and Thesis) + 4 hr. (Capstone Project)	27	11	3+ 3 Project and Thesis + 2 Capstone Project	19	5	2+ Project and Thesis+ Capstone Project
Grand Total	**113**	**87 + 6 wks**	**201+ 6 wks**	**113**	**47**	**160**	**39**	**25 + Survey + CESIP + Project and Thesis+ Capstone Project**

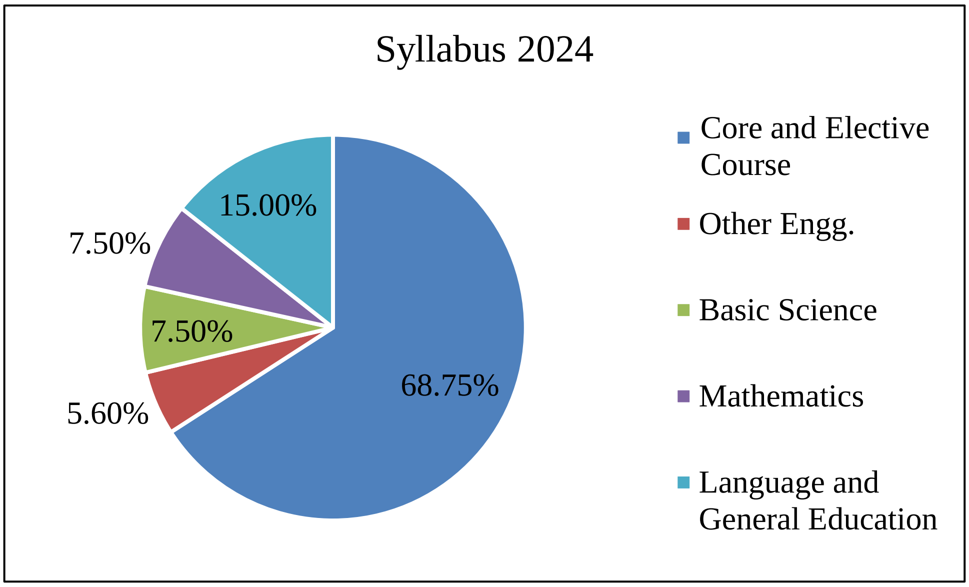
4.8 Summary of Departmental Theory and Sessional Courses - Level and Termwise Credit Hours

Level/ Term	Theory	Sessional	Total
Level-1 Term-I	3.0	1.5	4.5
Level-1 Term-II	3.0	1.5+1.5 Survey	4.5
Level-2 Term-I	9.0	4.5	13.5
Level-2 Term-II	9.0	3.0	12.0
Level-3 Term-I	14.0	3.0	17.0
Level-3 Term-II	16.0	3+1.5 CESIP	20.5
Level-4 Term-I	14.0	4.5+ 1 Project and Thesis + 1 Capstone Project	20.5
Level-4 Term-II	8.0	3+ 3 Project and Thesis + 2 Capstone Project	16
Total	**76.0**	**34.0**	**110.0**



4.9 Summary of Credit Hours for Departmental (core and elective), Inter-disciplinary, Basic Science. Mathematics, and General Education Courses

Level/ Term	Dept. (Core & Elective)	Inter-disciplinary	Basic Science	Mathematics	Language	General Education	Total
Level-1 Term-I	4.5	3	7.5	3	-	2	**20**
Level-1 Term-II	6	3	4.5	3	1.5	2	**20**
Level-2 Term-I	13.5	-	-	3	1.5	2	**20**
Level-2 Term-II	12	3	-	3	-	2	**20**
Level-3 Term-I	17	-	-	-	-	3	**20**
Level-3 Term-II	20.5	-	-	-	-	-	**20.5**
Level-4 Term-I	20.5	-	-	-	-	-	**20.5**
Level-4 Term-II	16	-	-	-	-	3	**19**
Total	110	9	12	12	3	14	160
% of Courses	**68.75%**	**5.6%**	**7.5%**	**7.5%**	**1.9%**	**8.75%**	**100.00%**



4.10 Teaching Strategy

Multiple teaching and learning activities are necessary to achieve the intended outcomes, since students have different learning styles. It is therefore, the CE department planned to choose appropriate teaching and learning methods that will foster student's engagement in the learning process rather than students listening to the lectures passively. Student centred learning is about active participation of students in the classroom, and that active participation will be achieved by content/curriculum, teacher's interaction with the students and the environment that are directed towards students learning. The strategy includes:

a. Face-to-Face Learning

- Lecture /Presentation/ Discussion
- Practical / Tutorial / Studio
- Case Studies
- Assignment/Quiz
- Group discussion/projects
- Design and Research

b. Self-Directed Learning

- Non-face-to-face learning
- Revision
- Preparation of presentation
- Preparation of Lab Reports
- Preparation of Lab Test
- Engagement in Group Projects
- Preparation of Assignment/Quiz
- Preparation for final Examination

Details of teaching strategy for each of the courses under the heading of Teaching Learning Strategy is given in Chapters 5 and 6.

4.11 Assesment Strategy

Assessment of student achievement is an important aspect of Outcome-based education. Students will be assessed both directly and indirectly. Direct Assessment includes class tests, assignments, and Mid and Term final examinations. However, appropriate rubrics have been set to evaluate indirect assessment. Assessment process is aligned with the learning outcomes. Assessment supports the learners in their progress and validates the achievement of the intended learning outcomes at the end of the lecture/course/module. Assessment methods are adapted depending on the kind of outcomes that are aimed to be achived. The assessment strategy is given below:

a. **Theory Based Courses**

SL.	Components		Grading
1	Continuous Assessment (40%)	Class Attendance	05%
		Class Performance	05%
		Class Test/ Assignment	20%
		Mid-term Exam/ Project	10%
2	Final Examination		60%
	Total Marks		**100%**

b. **Sessional Courses**

The CE department offers different types of sessional courses which include laboratory investigations, design through use of modern tools and softwares, field survey, drawing etc. Thereby assessments vary depending on selected course. The following represents a typical assessment strategy for a regular sessional course-

SL.	Components		Grading
1	**Continuous Assessment (60%)**	Class Performance	5%
		Conduct of Lab Test	20%
		Report Writing/Programming	15%
		Mid-term Evaluation (Exam/Project/Assignment)	20%
2	**Final Evaluation (40%)**	Final Exam (Exam/Project/Assignment)	30%
		Viva Voce/ Presentation	10%
	Total Marks		100%

Note: The above distribution of percentage is a general guideline. Department can rearrange to some extent if required.

Details of assessment strategy for each of the courses under the heading of assessment Strategy is given in Chapter 5.

CHAPTER 5

DETAILED SYLLABUS OF BASIC SCIENCE, MATHS, GENERAL EDUCATION, LANGUAGE, AND INTERDISCIPLINARY COURSES

5.1 Basic Sciences (Physics and Chemistry)

Physics

Spring Semester: Level 1 Term I

COURSE INFORMATION			
Course Code Course Title	: PHY 101 : Waves and Oscillations, Optics and Modern Physics	Contact Hours Credit hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course is the basic physics in the field of waves and oscillations, optics and modern physics. The course will be emphasized the basic concepts, theories and solve quantitative problems which can be applicable in a wide spectrum of engineering disciplines.			
OBJECTIVE			
• To define the different parameters, concepts, logical and critical thinking with scientific knowledge of waves and oscillations, optics and modern physics. • To explain the basic theories and laws of waves and oscillations, optics and modern physics. • To solve numerical and analytical problems regarding waves and oscillations, optics and modern physics.			
COURSE CONTENT			
Waves and Oscillations: Simple Harmonic Motion (SHM) and its properties, differential equation of a SHM and its solution, total energy and average energy of a body executing SHM, simple pendulum, torsional pendulum, spring-mass system, LC oscillatory circuit, two body oscillation and reduced mass, Composition of SHM, Damped oscillations, and its different condition, forced oscillations and its different condition, resonance, Wave motion : expression for a plane progressive wave, differential equation of wave motion, energy density of wave motion, average kinetic and potential energy of wave motion, Stationary wave. **Optics:** Combination of lens, equivalent lens and power, Defects of images and different aberrations, Interference of light, Young's double slit experiment, interference in thin films, Newton's ring, Diffraction of light, Fraunhofer and Fresnel diffraction, diffraction by single slit and double slit, diffraction grating, Fraunhofer diffraction at a circular aperture, resolving power of optical instrument, Polarization of light, Brewster's law, Malus law, polarization by double			

refraction, Nicole prism, optical activity and polarimeters, Laser: spontaneous and stimulated emission.

Modern Physics: Relativity : Frame of reference, postulates of special theory of relativity, Galilean transformation, Lorentz transformation, length contraction, time dilation, velocity addition, relativity of mass, mass energy relation, momentum energy relation, Photoelectric effect, Compton effect, de Broglie matter wave, Bohr atom model and explanation, atomic orbital and energy equation, classification of nuclei, nuclear mass and binding energy, Radioactivity, radioactive decay law, half-life, mean life, nuclear reaction, introduction to nuclear reactor.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Define** different basic laws and parameters in the field of waves and oscillations, optics and modern physics such as simple harmonic motion, damped oscillations, interference, diffraction, polarization, relativity, photoelectric effect, Compton effect, radioactivity, etc.	√											
2	**Explain** different basic theories in the field of waves and oscillations, optics and modern physics such as the SHM, damped motion, wave motion, interference, diffraction, polarization, special theory of relativity, Compton theory, nuclear transformation, nuclear reaction etc.	√											
3	**Solve** quantitative problems in the field of waves and oscillations, optics and modern physics such	√											

	as SHM, damped motion, wave motion, interference, diffraction, polarization, relativity, photoelectric effect, Compton shift, radioactivity, etc.												

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	**Define** different basic laws and parameters in the field of waves and oscillations, optics and modern physics such as simple harmonic motion, damped oscillations, interference, diffraction, polarization,relativity, photoelectric effect, Compton effect, radioactivity, etc.	1	C1	-	-	1	Quiz, Mid Term examination, Final Exam
CO2	**Explain** different basic theories in the field of waves and oscillations, optics and modern physics such as the SHM, damped motion, wave motion, interference, diffraction, polarization, special theory of relativity, Compton theory, nuclear	1	C2	-	-	1	Mid Term examination, Final Exam

	transformation, nuclear reaction etc.						
CO3	Solve quantitative problems in the field of waves and oscillations, optics and modern physics such as SHM,damped motion, wave motion, interference, diffraction, polarization,relativity, photoelectric effect, Compton shift, radioactivity, etc.	1	C3 C4	-	-	2	Class Assessment, Quiz, Mid Term examination, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorials/Assignment Preparation	22
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for test and examination	42 20
Assessment Pop quiz/ Class Test/Mid-Term Examination Final Examination	03 03

Total	132
TEACHING METHODOLOGY	
Lecture and Discussion, Problem Based Learning (PBL)	
TEACHING SCHEDULE	

Week	**Lectures**	**Topics**	**Assessments**
1	1	Introductory class: Brief discussion on total syllabus, basic requirements of the course, assessment of the course	CT/ Assignment
	2	Periodic motion, oscillatory motion, simple harmonic motion (SHM), properties of SHM, differential equations, general solution of SHM, graphical representation of SHM	
	3	Velocity, acceleration, phase and epoch, time period, frequency and angular frequency of SHM	
2	4	Total energy and average energy of SHM, problems	
	5	Simple pendulum, torsional pendulum, spring-mass system	
	6	LC oscillatory circuit, two body oscillations, reduced mass	
3	7	Composition of SHM	
	8	Composition of SHM, problems	
	9	Damped oscillations and its differential equation	
4	10	Displacement equation of damped oscillations and its different conditions, electric damped oscillatory circuit	CT/ Assignment
	11	Forced oscillations and its differential equation, displacement equation of forced oscillations, resonance	
	12	Wave motion: expression for a plane progressive wave, differential equation of wave motion, particle velocity, wave velocity	
5	13	Energy density of a plane progressive wave, average energy in a plane progressive wave, problems	
	14	Stationary wave: node, anti-node, problems	
	15	Lens and combination of lenses, equivalent lens, power of lens, cardinal points	
6	16	Defects of images and different aberrations	Mid Term/ Assignment
	17	Defects of images and different aberrations	

	18	Interference of light, young's double slit experiment	
7	19	Analytical treatment of interference, energy distribution	
	20	Interference fringes, interference in thin films	
	21	Newton's ring, Interferometer	
8	22	Diffraction: Fresnel & Fraunhofer diffraction, diffraction by single slit	
	23	Diffraction by double slit, diffraction gratings	
	24	Fraunhofer diffraction at a circular aperture, resolving power of optical instrument	
9	25	Polarization of light, Brewster's law, Malus' law	
	26	Polarization by double refraction, Nicol prism: Polarizer and analyzer	
	27	Optical activity: specific rotation, polarimeters	
10	28	Laser: spontaneous and stimulated emission, applications of laser	
	29	Theory of relativity: Frame of reference, postulates of special relativity, Galilean relativity, Galilean transformation	
	30	Lorentz transformations, length contraction, time dilation	
11	31	Velocity addition, relativistic mass and its expression,	
	32	Mass and energy equivalence equation and concept of massless particles and its expression, momentum energy relation, problems	
	33	Photoelectric effect, photocurrent and work function, kinetic energy, stopping potential	
12	34	Photoelectric equation, characteristics of photoelectric effect	CT/ Assignment
	35	Compton effect: definition, Compton wavelength shift, limitation	
	36	De Broglie concept, condition for wave and particle behavior, Bohr atomic model	
13	37	Expression for Bohr radii and orbital energy for hydrogen atom	
	38	Classification of nuclei, nuclear mass and nuclear binding energy	

	39	Radioactivity: Radioactive decay law, half- life	
14	40	Mean life, nuclear reaction: concept of Fusion, Fission and nuclear chain reaction	
	41	General idea on nuclear reactor and nuclear power plant	
	42	Review of the syllabus	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C1, C2, C3, C4
Final Exam	60%	CO1 CO2 CO3	C2 C3 C4
Total Marks	100%		

REFERENCE BOOKS

1. Physics for Engineers: Part-I and Part-II: Dr Giasuddin Ahmad
2. Physics, Volume I and Volume II: Resnick and Halliday
3. Fundamentals of Physics: Halliday, Resnick and Walker
4. Physics for Scientists and Engineers: Serway and Jewett
5. Waves and Oscillations: Brij Lal and Subramannyam

Physics

Fall Semester: Level 1 Term II

COURSE INFORMATION			
Course Code Course Title	: PHY 107 : Structure of Matter, Heat and Temperature, Kinetics and Kinematics	Contact Hours Credit hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course is the basic physics in the field of Structure of Matter, Heat and Temperature, Kinetics and Kinematics. The course will emphasize the basic concepts, theories and solve quantitative problems which can be applicable in a wide spectrum of engineering disciplines.			
OBJECTIVE			
• To define the different parameter and concepts of Structure of Matter, Heat and Temperature, Kinetics and Kinematics. • To explain the basic theories of Structure of Matter, Heat and Temperature, Kinetics and Kinematics. • To solve numerical problems regarding Structure of Matter, Heat and Temperature, Kinetics and Kinematics.			
COURSE CONTENT			
Structure of matter: Crystalline and non-crystalline solids, single crystal and poly-crystal solids, unit cell, crystal systems, co-ordinations number, crystal planes and directions, NaCl and CsCl structure, packing factor, Miller indices, relation between inter-planar spacing and Miller indices, Bragg's law, methods of determination of inter-planar spacing from diffraction patterns; defects in solids: point defects, line defects, surface defects, bonds in solids, band theory of solids: distinction between metal, semiconductor and insulator, inter-atomic distances, calculation of cohesive and bonding energy. **Heat and Temperature:** Heat energy and temperature; Thermal conductivity, specific heat, basic concept and equations of heat transfer, Workout Examples of Heat transfer through different mediums, rate of heat transfer; heat losses, conduction, convection and radiation. **Kinetics and Kinematics:** Introduction to Kinetics and Kinematics; Plane Motion (Linear, Curvilinear and Angular motion, Trajectory, Principles of Falling Objects, S.H.M.); Work, Kinetic Energy, Power, Impulse and Momentum.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

1	**Define** different basic parameters in the field of Structure of Matter, Heat and Temperature, Kinetics and Kinematics such as crystal structure, crystal defects, heat transfer, linear and angular momentum etc.	√											
2	**Explain** different basic theories in the field of Structure of Matter, Heat and Temperature, Kinetics and Kinematics such as the Bragg's law, bonding energy, thermal conductivity, Trajectory, Principles of Falling Objects etc.	√											
3	**Solve** quantitative problems in the field of Structure of Matter, Heat and Temperature, Kinetics and Kinematics such as packing factor, Miller indices, rate of heat transfer, Work, Kinetic Energy, Power, Impulse and Momentum etc.	√											

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Define** different basic parameters in the field	1	C1	-	-	1	Quiz, Mid Term

	of Structure of Matter, Heat and Temperature, Kinetics and Kinematics such as crystal structure, crystal defects, heat transfer, linear and angular momentum etc.						examination, Final Exam
CO2	**Explain** different basic theories in the field of Structure of Matter, Heat and Temperature, Kinetics and Kinematics such as the Bragg's law, bonding energy, thermal conductivity, Trajectory, Principles of Falling Objects etc.	1	C1/ C2	-	-	1	Mid Term examination, Final Exam
CO3	**Solve** quantitative problems in the field of Structure of Matter, Heat and Temperature, Kinetics and Kinematics such as packing factor, Miller indices, rate of heat transfer, Work, Kinetic Energy, Power, Impulse and Momentum etc.	1	C2	-	-	2	Class Assessment, Quiz, Mid Term examination, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks) Class assessment (2 hours/14 weeks)	 42 2
Guided Learning Tutorials/Assignment Preparation	 15
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for test and examination	 36 22
Assessment Pop quiz/ Class Test/Mid-Term Examination Final Examination	02 03
Total	120
TEACHING METHODOLOGY	
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)	

TEACHING SCHEDULE

Week	Lectures	Topics	Remarks
1	1	Introductory class: Brief discussion on total syllabus, basic requirements of the course, assessment of the course	CT/ Assignment/ Final Exam
	2	Classification of solids, types of crystalline solids, crystal, lattice, basis, crystal structure, plane lattice, space lattice, Bravais and non-Bravais lattices	
	3	Unit cell, lattice parameters, primitive and non-primitive cells and their distinctions, lattice symbols, crystal structure of NaCl and CsCl	
2	4	Unit face, axial units: linear and numerical parameters and, Miller indices	
	5	Atomic radius, packing factor and coordination number for different structures	
	6	Relation between lattice constant and density of solids and related numerical problems	
3	7	Inter-planer spacing, relation between inter-planar spacing and Miller indices, problems	

	8	X-ray diffraction, Bragg's law, methods of determination of inter-planar spacing from diffraction patterns problems	
	9	Defects in solids: point defects, line defects, surface defects	
4	10	Defects in solids: point defects, line defects, surface defects	CT/ Assignment/ Mid Term Exam
	11	Atomic arrangement in solid: different types of bonds in solids	
	12	Band theory of solids: valence band, conduction band, energy gap, distinction between metal, semiconductor and insulator	
5	13	Potential, cohesive energy, binding energy, Madelung constant, inter-atomic distance, calculation of total potential energy of a pair of atoms	
	14	Calculation of total potential energy at the equilibrium separation of an ionic crystal, problems	
	15	Heat energy and temperature	
6	16	Different thermometers	Mid Term/ Assignment/ Mid Term/ Final Exam
	17	Mathematical Problems	
	18	Mathematical Problems	
7	19	Thermal conductivity	
	20	specific heat	
	21	Mathematical Problems	
8	22	basic concept and equations of heat transfer	
	23	Workout of Heat transfer through different mediums	
	24	Mathematical Problems	
9	25	rate of heat transfer; heat losses, conduction, convection and radiation	
	26	rate of heat transfer; heat losses, conduction, convection and radiation	
	27	rate of heat transfer; heat losses, conduction, convection and radiation	
10	28	Mathematical Problems	
	29	Introduction to Kinetics and Kinematics	
	30	Plane Motion (Linear, Curvilinear and Angular motion, Trajectory, Principles of Falling Objects)	
11	31	Mathematical Problems	
	32	Plane Motion (Linear, Curvilinear and Angular motion, Trajectory, Principles of Falling Objects)	
	33	Mathematical Problems	

12	34	Plane Motion (Linear, Curvilinear and Angular motion, Trajectory, Principles of Falling Objects)	CT/ Assignment/ Final Exam
	35	Mathematical Problems	
	36	Work	
13	37	Work	
	38	Mathematical Problems	
	39	Kinetic Energy, Power	
14	40	Impulse and Momentum	
	41	Mathematical Problems	
	42	Mathematical Problems	

ASSESSMENT STRATEGY

Components	**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (Assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C1, C2, C3
Final Exam	60%	CO1, CO2, CO3	C1, C2, C3
Total Marks	100%		

REFERENCE BOOKS

1. Fundamentals of Physics: Halliday, Resnick and Walker
2. Physics for Scientists and Engineers: Serway and Jewett
3. Analytical Mechanics: V.M. Faires and S. D. Chambers
4. An Introduction to Mechanics: Daniel Kleppner and Robert Kolenkow
5. Introduction to Solid State Physics: Charles Kittle

Chemistry

Spring Semester: Level 1 Term I

COURSE INFORMATION			
Course Code	: CHEM 101	Contact Hours	: 3.00
Course Title	: Fundamentals of Chemistry	Credit hours	: 3.00

PRE-REQUISITE
None
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
This course is a basic chemistry covering the field of inorganic, organic and physical chemistry. The course emphasizes on the basic concepts, theories and solve quantitative problems which can be applied in a wide spectrum of engineering disciplines.
OBJECTIVE
• To define the different parameter and concepts of inorganic chemistry and physical chemistry. • To explain basic reaction mechanism of selective organic reactions. • To solve numerical problems of inorganic, organic and physical chemistry.
COURSE CONTENT
Atomic Structure: Concepts of atomic structure, Different atom models, quantum theory and electronic configurations, Heisenberg's uncertainty principle **Periodic Table:** Periodic classification of elements, Periodic properties of elements, Properties and uses of noble gases **Chemical Bonding:** Types and properties of chemical bonding, Lewis theory, VBT, MOT, Hybridization and shapes of molecules **Selective organic reactions:** Oxidation-reduction, Substitution, Addition, Polymerization, Alkylation reactions **Phase Rule:** Basic terms and phase rule derivation, Phase diagram of water **Solutions:** Solutions and their classification, Unit expressing concentration, Colligative properties and dilute solutions, Raoult’s law, Van’t Hoff’s law of osmotic pressure **Thermochemistry:** Laws of thermochemistry, Enthalpy, Hess's law, Heat of formation, Kirchoff’s equations, Heat of neutralization, Heat of reaction **Chemical Kinetics:** Order and rate of reaction, Pseudo and zero order reaction, Half-life, Determination and factors affecting the rate of a reaction, First order reaction, Second order reaction, Collision theory, Transition state theory **Chemical Equilibrium:** Equilibrium law/constant, Kp and Kc, Homogeneous and heterogeneous equilibrium, Van’t Hoff’s reaction isotherm, Le Chatelier's principle **pH & Buffer Solution:** Different concepts of acids-bases, Buffer solution, Mechanism of buffer solution, Henderson-Hasselbalch equation, Water chemistry and pH of water **Electrical properties of solution:** Conductors & nonconductors, difference between electrolytic and metallic conduction, electrolytic conductance, Factors influencing the conductivity of electrolytes, Kohlrausch Law & conductometric titrations.

COURSE OUTCOMES AND SKILL MAPPING													
No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Be able to **define/identify** the different parameters and fundamental concepts regarding Inorganic, Organic and Physical chemistry.	√											
2	Be able to **apply** different theory on chemical bonding and hybridization to determine structure of molecules.	√											
3	Be able to **explain/illustrate/derive** different theories based on colligative properties, chemical equilibrium, chemical kinetics, thermochemistry and electrochemistry, and the mechanism of selective organic reactions.	√											
4	**Solve/Analyze** different problems related to inorganic and physical chemistry		√										

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	Be able to **define/identify** the different parameters and fundamental concepts regarding Inorganic,	1	C1	-	-	1	Quiz, Mid Term Examination, Final Exam

	Organic and Physical chemistry.						
CO2	Be able to **apply** different theory on chemical bonding and hybridization to determine structure of molecules.	1	C3	-	-	1	Quiz, Mid Term Examination, Final Exam
CO3	Be able to **explain/illustrate/derive** different theories based on colligative properties, chemical equilibrium, chemical kinetics, thermochemistry and electrochemistry, and the mechanism of selective organic reactions.	1	C2	-	-	1	Quiz, Mid Term Examination, Final Exam
CO4	**Solve/Analyze** different problems related to inorganic and physical chemistry	2	C4	-	-	1	Class Assignment, Quiz, Mid Term Examination, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning	
Lecture	14
Practical / Experiment	28
Guided Learning	

Lab Report Preparation	18
Independent Learning Preparation of Lab-test Preparation of Quiz Preparation of Viva	 20 20 12
Assessment Continuous Assessment Quiz Final Lab Exam	 03 02 03
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Topic	Remarks
1	Concepts of atomic structure, Different atom models	Class Test, Final Exam
	Concepts of atomic structure, Different atom models	
	Quantum numbers, Electronic configurations	
2	Hydrogen spectral lines, Heisenberg's uncertainty principle	
	Classification of elements according to electronic configurations	
	Periodic classification of elements	
3	Periodic properties of elements, Properties and uses of noble gases	
	Periodic properties of elements, Properties and uses of noble gases	
	Chemical bonding (types, properties, Lewis theory, VBT)	
4	Molecular orbital theory (MOT)	Class Test, Final Exam
	Molecular orbital theory (MOT)	
	Hybridization and shapes of molecules	
5	Hybridization and shapes of molecules	
	Hybridization and shapes of molecules	
	Oxidation-reduction, Substitution	
6	Addition, Polymerization, Alkylation	
	Phase Rule: Basic terms and phase rule derivation	
	Phase diagram of water	
7	Different concepts of acids-bases	Mid Term, Final Exam
	Buffer solution, Mechanism of buffer solution	
	Henderson-Hasselbalch equation	
8	Solutions and their classification,	

	Units of expressing concentration	
	Effect of temperature and pressure on solubility, Validity and limitations of Henry’s law	
9	Colligative properties and dilute solutions	
	Raoult’s law, deviation from Raoult’s law, Elevation of boiling point	
	Freezing point depression, Van’t Hoff’s law of osmotic pressure	
10	Laws of thermochemistry, Enthalpy	
	Hess's law, Heat of formation, Kirchoff’s equations	
	Heat of neutralization, Heat of reaction	
11	Reversible reactions, Characteristics of chemical equilibrium, Law of mass action, Equilibrium constant, Units of equilibrium constant	Class Test, Final Exam
	Relation between K_p & K_C,Van’t Hoff’s reaction isotherm	
	Free energy and its significance Heterogeneous equilibrium	
12	Le Chatelier's principle	
	Reaction rate, Units of rate, Rate laws, Order of reaction, Molecularity of a reaction, Pseudo-order reaction	
	Reaction rate, Units of rate, Rate laws, Order of reaction, Molecularity of a reaction, Pseudo-order reaction	
13	First order reactions, 2nd order reactions, units of rate constant, half-life of a reaction	
	Collision theory of reaction rates, Effect of increase of temperature on reaction rate, Determination and factors affecting the rate of a reaction	
	Limitations of the collision theory, Transition state theory, Activation energy and catalysis	
14	Conductors & nonconductors, Difference between electrolytic and metallic conduction, Electrolytic conductance	
	Factors influencing the conductivity of electrolytes, Kohlrausch Law,	
	Conductometric titrations.	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class Assignments/ Class Test/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3, CO4	C1, C2, C3, C4
Final Examination	60%	CO1, CO2, CO3, CO4	C1, C2, C3, C4

Total Marks	100%		
REFERENCE BOOKS			
1. Modern Inorganic Chemistry – S. Z. Haider 2. Concise Inorganic Chemistry – J. D. Lee 3. A Textbook of Organic Chemistry – Arun Bahl and B. S. Bahl 4. Organic Chemistry – Morrison and Boyd 5. Principles of Physical Chemistry – Haque and Nawab 6. Essentials of Physical Chemistry – Bahl and Tuli 7. Physical Chemistry – Atkins			

Chemistry

Fall Semester: Level 1 Term II

COURSE INFORMATION			
Course Code Course Title	: CHEM 105 : Environmental Chemistry	Contact Hours Credit hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The course is concerned with the interactions of chemicals (natural or artificial) in air, water, soils and sediments which helps to understand the elements of pollution and their sources. Students will be acquainted with a solid knowledge of analytical chemistry to environmental processes which will be used in later semester and also in professional life.			
OBJECTIVE			
• To develop a in depth understanding of chemical processes underlying the operation of the natural environment. • To recognize the mobility of various contaminants in air, soils and waters. • To explain how human impacts on chemical processes can lead to degradation of the natural environment; • To understand the significance of contaminants.			
COURSE CONTENT			
Atmospheric chemistry: Atmospheric cycles; air pollution and pollutants - criteria and critical pollutants; ozone hole and stratospheric ozone depletion; chemical and photochemical reactions in atmosphere; hydrocarbons and photochemical smog. **Aquatic chemistry:** Water properties; solubility of gases and solids; colloidal suspension; Complexation reactions, solution approaches for aqueous equilibrium; Aqueous carbonate system; general concept on – alkalinity, pH, capacity diagram, electron activity; Redox equilibria; organic and inorganic pollutants; heavy metal contamination; adsorption isotherms; Chemical fate of pollutants. **Soil Chemistry:** Soil Composition; acid-base and ion exchange equilibria in soil, pollution mobilization from farming. Chemistry of pesticides, insecticides, anti-biotic and food preservatives.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

1	**Explain** the chemical and biochemical principles of fundamental environmental processes in air, water, and soil.	√											
2	**Identify** the elements of pollution, their sources, and how contaminants propagate in environment.		√										
3	**Understand** basic chemical concepts to analyze chemical processes involved in different environmental compartments.	√											

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’s Taxonomy	P	A	K	Assessment Methods
CO1	**Explain** the chemical and biochemical principles of fundamental environmental processes in air, water, and soil.	1	C2	-	-	1	Class Test, Mid-term, Final Exam
CO2	**Identify** the elements of pollution, their sources, and how contaminants propagate in environment.	2	C2	-	-	1	Class Test, Mid-term, Final Exam
CO3	**Understand** basic chemical concepts to analyze chemical processes involved in different	1	C2	-	-	2	Class Test, Mid-term, Final Exam

	environmental compartments.						

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	42 21
Assessment Continuous Assessment Final examination	2 3
Total	120

TEACHING METHODOLOGY

Lecture, Tutorials, Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Topics	Assessments
1	Introduction to environmental chemistry and chemistry concepts	Class Test, Final exam
	Pollution perspective	
	Major pollutants	
2	Fate and behavior of chemicals in environment	
	Ecological concepts in the environment	

	Types, sources, and degradation of pollutants	Final exam
3	Atmospheric cycles; air pollution, and pollutants - criteria and critical pollutants;	
	Effect of air pollution on human	
	Effect of air pollution on vegetation, and materials	
4	ozone hole and stratospheric ozone depletion,	Mid Term, Final exam
	Climate change, Greenhouse gas emission.	
	Air chemistry, chemical and photochemical reactions in atmosphere	
5	Chemical and photochemical reactions in atmosphere	
	hydrocarbons and photochemical smog.	
	Case studies	
6	Introduction to aqueous chemistry	Class Test, Final exam
	Solubility of gases and solids	
	Colloidal suspension	
7	complexation reactions	
	Solution approaches for aqueous equilibrium	
	Aqueous carbonate system, General concept on – alkalinity, pH, capacity diagram, electron activity	Mid Term, Final exam
8	General concept on – alkalinity, pH, capacity diagram, electron activity	
	Redox reactions, equilibria	
	Complexation reaction	
9	Organic and inorganic pollutants, Aliphatic compounds, Heterocyclic compounds	
	Behavior of organics in water	Class Test, Final exam
	Adsorption isotherms	
10	Heavy metal contamination	
	Chemical fate of pollutants in water	Final exam`
	Chemical fate of pollutants in water	
11	Case studies	
	Introduction to soil chemistry	
	Soil Composition;	
12	Acid-base and ion exchange equilibria in soil	
	Acid-base and ion exchange equilibria in soil	

	Pollution mobilization from farming.	
13	Chemistry of pesticides and insecticides	
	Insecticides	
	Anti-biotics in environments	
14	Food preservatives	
	Case studies	
	Review class	-

ASSESSMENT STRATEGY

Components	Grading	CO	Blooms Taxonomy
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C2, C2, C3
Final Exam	60%	CO1	C2
		CO2	C2
		CO3	C3
Total Marks	100%		

REFERENCE BOOKS

1. General Chemistry – by Ebbing, D.D. AITBS Publishers & Distributors, Delhi.
2. Chemistry and Chemical Reactivity, J.C. Kotz and Paul Treichel, (Sanders)

Physics Sessional

Fall Semester: Level 1 Term II

COURSE INFORMATION			
Course Code Course Title	: PHY 102 : Physics Sessional	Contact Hours Credit hours	: 3.00 : 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is a laboratory course for the basic physics in the field of waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics. The course will be emphasized the fundamental experiments on different fields of physics which can be applicable in a wide spectrum of engineering disciplines. This laboratory course will enable students to understand basic physics practically as well as do work with team or individual.

OBJECTIVE

- To develop basic physics knowledge practically
- To practice use of basic scientific instrument

COURSE CONTENT

Quantitative measurement of different parameters in the field of waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics such as:

Specific resistance of materials, high resistance, resistance of a galvanometer, Electrochemical equivalent (ECE) of copper, comparison of the E.M.F's of two cells, radius of curvature, wavelength of light, focal length of lens, specific rotation of sugar, refractive index of a liquid, thermal conductivity of a bad conductor, temperature co-efficient of resistance, pressure co-efficient of a gas, specific heat of a liquid, acceleration due to gravity, spring constant, rigidity modulus, young's modulus, moment of inertia, conservation of linear momentum, frequency of a tuning fork, surface tension, Planck's constant.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Define** the different parameters regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	√											
2	**Describe** the different phenomena regarding	√											

	waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.												
3	**Construct** experiments by an individual or by a group to determine different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.									√			
4	**Prepare** a report for an experimental work.										√		

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	**Define** the different parameters regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	1	C1	-	-	1	Quiz, Final Exam
CO2	**Describe** the different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	1	C1	-	-	1	Test, Final Exam

CO3	**Construct** experiments by an individual or by a group to determine different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	9	C2	-	-	2	Test, Final Exam
CO4	**Prepare** a report for an experimental work.	10	C2	-	-	2	Report

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning	
Lecture	14
Practical / Experiment	28
Guided Learning	
Lab Report Preparation	18
Independent Learning	
Preparation of Lab-test	20
Preparation of Quiz	20
Preparation of Viva	12
Assessment	
Continuous Assessment	03
Quiz	02
Final Lab Exam	03

Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Experiments.

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	3	Introductory class: Brief discussion on total syllabus, basic requirements of the course, evaluation system of the course, grouping, visit different section of the laboratory, introduction to different basic equipment	Quiz, Test, Final Examination, Report
2	6	Determination of the specific resistance of a wire using meter bridge or determination of ECE of copper by using copper voltameter	
3	9	Determination of high resistance by the method of deflection and determination of resistance of a galvanometer by half deflection method	
4	12	Determination of the wavelength of sodium light by a spectrometer using a plane diffraction grating or determination of the specific rotation of sugar by polarimeter	
5	15	Determination of the radius of curvature of a plano-convex lens by Newton’s ring method	
6	18	Determination of the moment of inertia of a Fly-wheel about its axis of rotation	
7	21	Determination of the thermal conductivity of a bad conductor by Lee’s method or determination of specific heat of a liquid by the method of cooling	
8	24	Determination of the value of g acceleration due to gravity by means of a compound pendulum	
9	27	Determination of the spring constant, effective mass and the rigidity modulus of the spring or determination of the Young’s modulus of bar by bending method	
10	30	Determination of the frequency of a tuning fork by Melde’s experiment or verification of the law of conservation of linear momentum	
11	33	Determination of the Planck’s constant using photoelectric effect or determination of focal length of a concave lens by auxiliary lens method	
12	36	Viva & lab final experimental exam	
13	39	Viva & lab final experimental exam	
14	42	Quiz exam	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class performance, Report Writing)	40%	CO1, CO4	C1, C2
Final Examination Lab Test Viva Quiz	 30% 10% 20%	CO1, CO2, CO3	C1, C2
Total Marks	100%		

REFERENCE BOOKS
1. Practical Physics: G. L. Squires 2. Practical physics for degree students: Dr Giasuddin and Md. Sahabuddin 3. B.Sc. Practical Physics: C. L Arora 4. Practical Physics: S.L. Gupta and V. Kumar

Chemistry Sessional

Spring Semester: Level 1 Term I

COURSE INFORMATION			
Course Code Course Title	: CHEM 102 : Chemistry Sessional	Contact Hours Credit hours	: 3.00 : 1.50
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course is a laboratory course for the basic chemistry in the field of inorganic and physical chemistry. The course will be emphasized by fundamental experiments on different fields of chemistry which can be applicable in a wide spectrum of engineering disciplines. This laboratory course will enable students to understand basic chemistry practically as well as do work with team or individual.			
OBJECTIVE			
• To familiarize the students with experimentation of acid and base neutralization, titration and quantitative analysis of metals etc. • To make students proficient in iodimetric and iodometric analysis and complexometric titration etc. • To develop students' ability in estimating zinc, ferrous content in water sample by using various titrimetric methods.			
COURSE CONTENT			
Quantitative chemical analysis in the field of inorganic and physical chemistry such as: Acid-base titration, Redox titration, Iodometric and Iodometric titration, Complexometric titration. Na2-EDTA) Solution by using Eriochrome black T indicator.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Be able to **describe** the different parameters regarding acid and base neutralization, titration and quantitative analysis of metals etc. and others key words like primary standard substances,	√											

	secondary standard substances, molarity, normality, indicator, equivalent weights and so on.												
2	Be able to **perform** experimentation regarding iodimetric and iodometric method, complexometric titration etc.					√							
3	Be able to **measure** zinc, ferrous content in water sample by using various titrimetric methods.					√							

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	Be able to **describe** the different parameters regarding acid and base neutralization, titration and quantitative analysis of metals etc. and others key words like primary standard substances, secondary standard substances, molarity, normality, indicator, equivalent weights and so on.	1	C1	-	-	1	Quiz

CO2	Be able to **perform** experimentation regarding iodimetric and iodometric method, complexometric titration etc.	5	C5	-	-	6	Test, Final Exam
CO3	Be able to **measure** zinc, ferrous content in water sample by using various titrimetric methods.	5	C5	-	-	6	Test, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning	
Lecture	14
Practical / Experiment	28
Guided Learning	
Lab Report Preparation	18
Independent Learning	
Preparation of Lab-test	20
Preparation of Quiz	20
Preparation of Viva	12
Assessment	
Continuous Assessment	03
Quiz	02
Final Lab Exam	03

Total	120
TEACHING METHODOLOGY	
Lecture and Discussion, Co-operative and Collaborative Method, Experiments	
TEACHING SCHEDULE	

Week	**Topics**	**Remarks**
1	Orientation and Introductory lecture	Quiz, Test, Final Examination, Report
2	Standardization of Sodium Hydroxide (NaOH) Solution with Standard Oxalic Acid dihydrate ($C_2H_2O_4.2H_2O$) Solution	
3	Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Hydroxide (NaOH) Solution.	
4	Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Carbonate (Na_2CO_3) Solution	
5	Determination of Calcium (Ca) Content in a Calcium Chloride dihydrate ($CaCl_2.2H_2O$) Solution with Standard Di-Sodium Ethylenediaminetetraacetic Acid (Na_2EDTA) Solution.	
6	Mid Term	
7	Standardization of Sodium Thiosulphate Pentahydrate ($Na_2S_2O_3.5H_2O$) Solution with Standard Potassium Dichromate ($K_2Cr_2O_7$) Solution.	
8	Estimation of Copper (Cu) Content in a Copper Sulphate Pentahydrate ($CuSO_4.5H_2O$) (Blue Vitriol) Solutions by Iodometric Method with Standard Sodium Thiosulphate Pentahydrate ($Na_2S_2O_3.5H_2O$) Solution.	
9	Standardization of Potassium Permanganate ($KMnO_4$) Solution with Standard Oxalic Acid dihydrate ($C_2H_2O_4.2H_2O$) Solution.	
10	Determination of Ferrous (Fe) Content in a Ammonium Ferrous Sulphate (Mohr`s Salt) [$FeSO_4(NH_4)_2SO_4.6H_2O$] Solution with Standard Potassium Permanganate ($KMnO_4$) Solution.	
11	Revision class and final lecture	-
12	Exam	-
13	Viva	-
14	Reserved for exam (if required)	-

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment Class performance Report Writing	 10% 30%	CO1, CO2, CO3	C1, C5

Final Examination Lab Test Viva Quiz	 30% 10% 20%	CO1, CO2, CO3	C1, C5
Total Marks	100%		

REFERENCE BOOKS

1. Practical Physics: G. L. Squires
2. Practical physics for degree students: Dr Giasuddin and Md. Sahabuddin
3. B.Sc. Practical Physics: C. L Arora
4. Practical Physics: S.L. Gupta and V. Kumar

5.2 Mathematics

Spring Semester: Level 1 Term I

COURSE INFORMATION			
Course Code Course Title	: MATH 101 : Differential and Integral Calculus	Contact Hours Credit hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The purpose of this course is to impact basic knowledge of differential calculus and how to use it in engineering problem.			
OBJECTIVE			
• Define the limit, continuity and differentiability of functions, identify the rate of change of a function with respect to independent variables and describe the different techniques of evaluating indefinite and definite integrals. • Apply the concepts or techniques of differentiation and integration to solve the problems related to engineering study. • Calculate the length, area, volume, center of gravity and average value related to engineering study.			
COURSE CONTENT			
Differential Calculus: Introduction, Differential Calculus for Engineering, Function and Limit, Continuity and Differentiability, Successive Differentiation, Leibnitz's Theorem, Rolle's Theorem, Mean Value Theorem, Taylor's theorem, Expansion of Finite and Infinite forms, Lagrange's form of remainder, Cauchy's form of remainder, Expansion of functions differentiation and integration, Indeterminate form, Cartesian differentiation, Euler's theorem, Tangent, sub tangent and Normal, sub normal, Maxima and Minima, Curvature, Asymptotes, Partial differentiation. **Integral Calculus:** Definition of Integration, Importance of Integration in Eng., Integration by substitution, Integration by parts, Standard integrals, Integration by successive reduction, Definite integrals and its use, Integration as a limit of sum, summing series, Walli's formula, Improper Integrals, beta and gamma function, multiple integral and its application, Area, volume of solid revolution, Area under a plain curve, Area of the region enclosed by two curves, Arc lengths of curves.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

1	**Know** the rate of change of a function with respect to independent variables and the different techniques of evaluating indefinite and definite integrals.	√											
2	**Apply** the concepts or techniques of differentiation and integration to solve the problems related to engineering study.	√											
3	**Calculate** the length, area, volume, center of gravity and average value related to engineering study.	√											

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Know** the rate of change of a function with respect to independent variables and the different techniques of evaluating indefinite and definite integrals.	1	C1	-	-	1	Class Test, Assignment, Final Exam
CO2	**Apply** the concepts or techniques of	1	C3	-	-	1	Class Test, Mid-term, Final Exam

	differentiation and integration to solve the problems related to engineering study.						
CO3	**Calculate** the length, area, volume, center of gravity and average value related to engineering study.	1	C3	-	-	1	Assignment, Mid-term, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments	-
Independent Learning Individual learning Preparation for tests and examination	 84 21
Assessment Continuous Assessment Mid Term Examination Final Examination	 2 1 3
Total	153

TEACHING METHODOLOGY

Lecture, Tutorials, Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Topics	Remarks
1	Introduction to Differential Calculus for Engineering study, Limit of a function and its properties.	Class Test, Final Exam
	Basic limit theorems with proofs, Limit of infinity and infinite limit, Sandwich (Squeezing) theorem with problems.	
	Concept of Differentiation, definition, classification of discontinuity and solving problems	
2	Basic concept of Differentiability, definition, derivative of a function, differentiable function.	
	Differentiability – one sided derivative (R.H.D and L.H.D), solving problems	
	Successive differentiation – Concept and problem solving	
3	Leibnitz's theorem and its applications	
	Determination of $(y_n)_0$	
	Mean Value theorem, Taylor theorem	
4	Expansion of finite and infinite forms, Lagrange's and Cauchy's form of remainder.	Class Test, Final Exam
	Indeterminate forms – concept and problem solving,	
	L'Hospital's rules with application	
5	Partial differentiation - partial derivatives of a function of two variables and problems	
	Partial differentiation - partial derivatives of a homogeneous function of two variables, Euler's theorem for two variables and problems	
	Partial differentiation - partial derivatives of a homogeneous function of several variables, Euler's theorem for several (three and m) variables and problem solving	
6	Addition, Polymerization, Alkylation	
	Phase Rule: Basic terms and phase rule derivation	
	Phase Diagram of water and carbon dioxide	
7	maxima and minima of functions of single variables – concept, Increasing and decreasing function, Concave up and down with problems	
	Curvature	
	Asymptotes	
8	Introduction to integral calculus	Mid Term Examination, Final Exam
	Standard integrals – concept of definite and indefinite integrals, applications.	
	Indefinite integrals – Method of substitution, Techniques of integration	
9	Indefinite integrals – Integration by parts, Special types of integration, integration by partial fraction,	
	Integration by the method of successive reduction	
	Definite integrals – definite integrals with properties and problems	

10	Definite integrals – Reduction formula, Walli's formula	
	Definite integrals – definite integral as the limit of the sum	
	Beta function – concept and problem solving	
11	Gamma function - concept and problem solving	Class Test, Mid Term Examination, Final Exam
	Relation between beta and gamma function, Legendre duplication formula, problems and applications	
	Multiple integrals – double integrals	
12	Multiple integrals – triple integrals	
	Multiple integrals – successive integration for two and three variables	
	Area in Cartesian	
13	Area in polar	
	Volume of solid revolution	
	Area under a plain curve in Cartesian and polar coordinates	
14	Area of a region enclosed by two curves in Cartesian and polar coordinates	
	Arc lengths of curves in Cartesian coordinates	
	Arc lengths of curves in polar coordinates	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C1, C3
Final Exam	60%	CO1	C1, C3
		CO2	C3
		CO3	C3
Total Marks	100%		

REFERENCE BOOKS

1. Howard Anton, Irl C. Bivens, Stephen Davis, Calculus, 12th Edition, Wiley, 2021.
2. Morris Kline, Calculus: An Intuitive and Physical Approach, 2nd Edition, Courier Corporation, 2013.

Mathematics
Fall Semester: Level 1 Term II

COURSE INFORMATION			
Course Code Course Title	: MATH 103 : Differential Equations and Matrix	Contact Hours Credit hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The purpose of this course is to impact basic knowledge to identify and solve differential equations and concept of matrix.			
OBJECTIVE			
• Be able to impart basic knowledge on ordinary and partial differential equations. • Developing understanding some of the important aspects of ordinary and partial differential equations. • Be able to provide knowledge on using concept of Differential equations and matrix in engineering problems and solve other applied problems. • Be expert in imparting in depth knowledge on inverse matrix.			
COURSE CONTENT			
Differential Equations: Introduction & Formulation of DE in Engineering, Degree and order of ODE, solution of first order but higher degree DE by various methods, solution of general DEs of second and higher order, Solution of Euler's homogeneous linear DEs, Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial, linear first order PDE, Non linear first order PDE, Standard form DEs of higher order and wave equation, particular solutions with boundary and initial condition, Non-linear PDE of order one, Charpit's method, Linear PDE with constant coefficients, Applications of DE. **Matrix:** Definition of Matrix, different types of matrices, Algebra of Matrices, Transpose and adjoint of a matrix and inverse matrix, rank and elementary transformation, solution of linear equation or System of Linear Equation, Matrix polynomials determination characteristic roots and vectors, characteristic subspace of matrix and Eigen values and Eigen Vectors, Cayley Hamilton.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Define** various types of differential equations	√											

	and the classifications of partial differential equations.												
2	**Solve** ordinary and partial differential equations by using different rules.	√											
3	**Apply** the technique of inverse matrix and echelon form to get the solution of System of Linear Equation.	√											

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Define** various types of differential equations and the classifications of partial differential equations.	1	C1, C2	-	-	3	Class Test, Assignment, Final Exam
CO2	**Solve** ordinary and partial differential equations by using different rules.	1	C3	-	-	3	Class Test, Mid-term, Final Exam
CO3	**Apply** the technique of inverse matrix and echelon form to get the solution of System of Linear Equation.	1	C3	-	-	3	Assignment, Mid-term, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence **Complex Engineering Activities (A)**: **A1**: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity **Bloom's Taxonomy Levels**: **C1**: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorials/Assignment Preparation	22
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for test and examination	42 20
Assessment Pop quiz/ Class Test/Mid-Term Examination Final Examination	03 03
Total	132

TEACHING METHODOLOGY

Lecture, Tutorials, Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Topics	Assessments
1	Introduction & Formulation of DE in Eng, Degree and order of ODE	Class Test, Final Exam
	Introduction & Formulation of DE in Eng, Degree and order of ODE	
	Introduction & Formulation of DE in Eng, Degree and order of ODE	
2	Solution of first order but higher degree DE by various methods	
	Solution of first order but higher degree DE by various methods	
	Solution of first order but higher degree DE by various methods	
3	Solution of general DEs of second and higher order, Solution of Euler's homogeneous linear DEs	
	Solution of general DEs of second and higher order, Solution of Euler's homogeneous linear DEs	
	Solution of general DEs of second and higher order, Solution of Euler's homogeneous linear DEs	

4	Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial	Class Test, Final Exam
	Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial	
	Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial	
5	Linear first order PDE, Non-linear first order PDE	
	Standard form DEs of higher order and wave equation	
	Standard form DEs of higher order and wave equation	
6	Particular solutions with boundary and initial condition, Non-linear PDE of order one: Charpit's method	
	Particular solutions with boundary and initial condition, Non-linear PDE of order one: Charpit's method	
	Particular solutions with boundary and initial condition, Non-linear PDE of order one: Charpit's method	
7	Linear PDE with constant coefficients, Applications of DE	
	Linear PDE with constant coefficients, Applications of DE	
	Linear PDE with constant coefficients, Applications of DE	
8	Wave equations	Mid Term Examination, Final Exam
	Particular solutions with boundary and initial conditions	
	Particular solutions with boundary and initial conditions	
9	Second order PDE and classifications to canonical (standard)-parabolic, elliptic, hyperbolic solution by separation of variables,	
	Second order PDE and classifications to canonical (standard)-parabolic, elliptic, hyperbolic solution by separation of variables,	
	Second order PDE and classifications to canonical (standard)-parabolic, elliptic, hyperbolic solution by separation of variables,	
10	Application of OD and PDE in Eng study	
	Definition of Matrix, different types of matrices, Algebra of Matrices,	
	Transpose and adjoint of a matrix and inverse matrix	
11	Solution of linear equation or System of Linear Equation	Class Test, Final Exam
	Solution of linear equation or System of Linear Equation	
	Solution of linear equation or System of Linear Equation	
12	Solution of linear equation using Inverse Matrix	
	Rank, Nullity and elementary transformation	
	Rank, Nullity and elementary transformation	
13	Dependent and independent of vectors	
	Dependent and independent of vectors with examples	
	Matrix polynomials determination characteristic roots and vectors	
14	Characteristic subspace of matrix and Eigen values and Eigen Vectors,	

	Characteristic subspace of matrix and Eigen values and Eigen Vectors,	
	Cayley Hamilton theorem and its application. Finding inverse matrix using this theorem.	

ASSESSMENT STRATEGY

Components	Grading	CO	Blooms Taxonomy
Continuous Assessment (Assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C1, C2, C3
Final Exam	60%	CO1	C1, C2
		CO2	C3
		CO3	C3
Total Marks	100%		

REFERENCE BOOKS

1. Howard Anton, Chris Rorres, Anton Kaul, Elementary Linear Algebra ,12th Edition, John Wiley & Sons, 2019
2. Dr. M.D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand Publishing, 2013

Mathematics

Spring Semester: Level 2 Term I

COURSE INFORMATION			
Course Code Course Title	: MATH 201 : Vector Analysis, Laplace Transform and Coordinate Geometry	Contact Hours Credit hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The purpose of this course is to introduce basic knowledge to identify and solve vector mathematical problems, to demonstrate practical applications of Laplace Transform and analyze co-ordinate geometry.			
OBJECTIVE			
• Be able to impart basic knowledge on ordinary and partial differential equations. • Developing understanding of some of the important aspects of ordinary and partial differential equations. • Be able to provide knowledge on using concept of Differential equations and matrix in engineering problems and solve other applied problems. • Be expert in imparting in depth knowledge on inverse matrix.			
COURSE CONTENT			
Vector Analysis: Definition of Vector and scalers & vector algebra, Scaler and vector products of two vectors and their geometrical interpretation, Triple products and multiple products, Linear dependence and independence of vectors, Differentiation of vectors, Gradient of scaler functions, Divergence and curl of point functions, physical significance of gradient, divergence and curl, Definition of line, surface and volume integral, Integration of Vectors, Green's theorem and its application, Stoke's theorem and its application, Gauss theorem and its application in Engineering. **Laplace Transform:** Definition of LT and Application of LT for Engineering, LT of some elementary functions and properties of LT, Sufficient condition for existence of LT, Inverse LT, LT of derivatives, Unit step function, Periodic function, Some special theorems on LT, Partial fraction, Solution of DEs by LT, Heaviside expansion formula, Convolution theorem, Evaluation of improper integral, Application of LT. **Co-ordinate Geometry:** Introduction to geometry for Engineering and Rectangular co-ordinates, Transformation of co-ordinates, changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties, circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves, equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points), Three dimensional co-ordinate system,			

direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid straight lines, standard equation of coincides, sphere and ellipsoid.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Know** the physical explanation of different vector notation and Laplace transform, inverse Laplace transform, some properties and definition of Geometry.	√											
2	**Explain** the characteristics of conics and familiarize with straight lines, pair of straight lines, circles, radical axis and center in 2D and 3D co-ordinate systems.	√											
3	**Calculate** length, volume and area of objects related to engineering study by using vector.	√											
4	**Apply** Laplace transform to ODE and PDEs and the knowledge of geometry specially the pair of straight lines, circles, system of circles, parabola, ellipse etc in engineering study.	√											

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	**Know** the physical explanation of different vector notation and Laplace transform, inverse Laplace transform, some properties and definition of Geometry.	1	C1, C2	-	-	1	Assignment, Class Test, Final Exam
CO2	**Explain** the characteristics of conics and familiarize with straight lines, pair of straight lines, circles, radical axis and center in 2D and 3D co-ordinate systems.	1	C2	-	-	1	Class Test, Mid-Term Exam, Final Exam
CO3	**Calculate** length, volume and area of objects related to engineering study by using vector.	1	C3	-	-	1	Assignment, Mid-Term Exam, Final Exam
CO4	**Apply** Laplace transform to ODE and PDEs and the knowledge of geometry specially the pair of straight lines, circles, system of circles, parabola, ellipse etc in engineering study.	1	C3	-	-	1	Assignment, Mid-Term Exam, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments	-
Independent Learning Individual learning Preparation for tests and examination	 84 21
Assessment Continuous Assessment Mid Term Examination Final Examination	 2 1 3
Total	153

TEACHING METHODOLOGY

Lecture, Tutorials, Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Topics	Assessments
1	Definition of Vector and scalers & vector algebra, Scaler and vector products of two vectors and their geometrical interpretation	Class Test, Final Exam
	Definition of Vector and scalers & vector algebra, Scaler and vector products of two vectors and their geometrical interpretation	
	Definition of Vector and scalers & vector algebra, Scaler and vector products of two vectors and their geometrical interpretation	
2	Triple products and multiple products, Linear dependence and independence of vectors, Differentiation of vectors	
	Gradient of scaler functions, Divergence and curl of point functions	
	Physical significance of gradient, divergence and curl	

3	Definition of line, surface and volume integral, Integration of Vectors, Green's theorem and application	
	Definition of line, surface and volume integral, Integration of Vectors, Green's theorem and application	
	Green’s theorem and its application	
4	Gauss theorem and application in Engineering	Class Test, Final Exam
	Stoke's theorem and its application.	
	Introduction to geometry for Engineering and Rectangular co-ordinates, Transformation of co-ordinates	
5	Introduction to geometry for Engineering and Rectangular co-ordinates, Transformation of co-ordinates, changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties	
	Changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties	
	Changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties	
6	Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves	
	Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves	
	Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves	
7	Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves	
	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	
	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	
8	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	Mid Term Examination,

	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	Final Examination
	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	
9	Three-dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid	
	Three-dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid	
	Three-dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid	
10	Three-dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid	
	Definition of LT and Application of LT for Engineering, LT of some elementary functions and properties of LT	
	Definition of LT and Application of LT for Engineering, LT of some elementary functions and properties of LT	
11	Sufficient condition for existence of LT	Class Test, Final Exam
	LT of derivatives and its application	
	LT of Integration with application, LT of sine and cosine integral	
12	Unit step function and its application	
	Periodic function with examples, LT of some special function.	
	Definition of inverse Laplace Transform and its properties	
13	Partial fraction and its application in inverse Laplace Transform	
	Heaviside formula and its application	

	Convoulution theorem, Evaluation of improper integral, Application of LT	
14	Solve ODE s by Laplace transform	
	Solve PDE s by Laplace transform	
	Application of LT in Eng. study	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C1, C2, C3
Final Exam	60%	CO1	C1, C2
		CO2	C2
		CO3	C3
		CO4	C3
Total Marks	100%		

REFERENCE BOOKS

1. Vector Analysis, 2nd Edition 2nd Edition by Murray Spiegel, Seymour Lipschutz, Dennis Spellman
2. Schaum's Outline of Laplace Transforms by Murray R. Spiegel
3. Engineering Mathematics, Volume Two 2 II: Containing Coordinate Geometry of Two Dimensions, Co-ordinate Geometry of Three Dimensions, Matrices.
4. Theory of Equations and Vector Calculus by K. Kandasamy, P.; Thilagavathy, K.; Gunavathy
5. A Text Book on Co-ordinate Geometry with Vector Analysis - Rahman & Bhattacharjee.

Mathematics

Fall Semester: Level 2 Term II

COURSE INFORMATION			
Course Code Course Title	: MATH 203 : Applied Mathematics for Engineers	Contact Hours Credit hours	: 3.00 : 3.00
PRE-REQUISITE			
MATH 103			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
In this course students will be introduced to various methods to solve various civil engineering problems dealing with probability and statistics. Students will also be able to apply different methods to solve differential equations.			
OBJECTIVE			
• To understand the basic concepts of probability distributions, Bayesian inference and relevant statistical methods. These concepts comprise foundational material utilized heavily in later year courses, particularly in water, structural, and geotechnical engineering. • To formulate civil engineering problems dealing with probability and statistics into mathematical frameworks and solve the resulting models. • To help the students to solve various differential equations using several methods like power series solution, method of Frobenius etc. Besides that, students will also be able to develop Fourier series for different kind of elements related to civil engineering structures.			
COURSE CONTENT			
Review of differential equations; power series solution of differential equations and their applications: Frobenius method, Legendre's polynomials, gamma function, Bessel's function; integral form of differential equation and its application to engineering problem solving. Fourier series and its properties, application to engineering problem solving; Fourier integral; Fourier transforms and their uses in solving boundary value problems. Application of statistical methods to engineering problems: Random variables; discrete and continuous probability distributions; functions of random variables and derived distributions; expectation and moments of random variables; point estimation of distribution parameters: methods of moments and maximum likelihood, Bayesian analysis; confidence intervals; hypothesis tests; nonparametric statistical tests; simple and multiple linear regression and model selection; uncertainty and reliability analysis; project level decision making and quality control.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

1	**Apply** differential equation and Fourier analysis to solve civil engineering problems	√											
2	**Apply** probability distribution theory and Bayesian inference to civil engineering problems focusing probability and statistical analysis		√										
3	**Develop** simple probabilistic models to evaluate uncertainty in civil engineering systems.	√											

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	**Apply** differential equation and Fourier analysis to solve civil engineering problems	1	C3	-	-	3	Class Test/Class Assignment/Final exam
CO2	**Apply** probability distribution theory and Bayesian inference to	2	C3	-	-	3	Class Test/Class Assignment/Final exam

	civil engineering problems focusing probability and statistical analysis						
CO3	**Develop** simple probabilistic models to evaluate uncertainty in civil engineering systems.	1	C4	-	-	3	Class Test/Class Assignment/Final exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Assignment Preparation (3.0 hours/week x 04 weeks)	12
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for quiz and final exam	48 7
Assessment Continuous assessment (Assignment/ Class Test) Final Exam	08 03

Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Topics	Assessments
1	Background of statistical applications in Civil engineering.	Final Exam
	Introduction sample space, Venn diagram and probability model.	
2	Conditional probability, Joint Probability.	Class Test/Class Assignment/ Final Exam
	Baye’s theorem, Bayesian statistics	
	Probability distribution functions and probability mass function.	Mid Term/ Class Assignment/ Final Exam
3	Joint probability mass function, cumulative distribution function, joint probability density function	
	Continuous random variable functions, Indicator random variables, Variance, Co-variance of two random variables	
	Bernoulli Distribution, Binomial distribution	
4	Poisson distribution	
	Moment generating function	
	Uniform distribution	
5	Normal Distribution	
	Standard Normal Distribution	
	Exponential Distribution	
6	Central Limit Theorem, Sample mean and sample variance	
	Quality criteria for estimates	
	Point estimation, method of likelihood Method of moments, interval estimation	Class Test/Final Exam
7	Hypothesis testing	
	Confidence interval	
	Linear Models, linear regression analysis	

8	Review of differential equation, power series solution	Mid Term/ Class Assignment/ Final Exam
9	Method of Frobenius	Final Exam
10	Legendre Polynomial	
11	Gamma Function	
12	Bessel's Function	Class Test / Final Exam
13	Fourier Series, Fourier Integral	Class Test/ Final Exam
14	Fourier Transform	Class Assignment/ Final Exam

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Class Test/Class Assignment/Mid Term	40%	CO1, CO2, CO3	C3, C4
Final Exam	60%	CO1, CO2, CO3	C3, C4
Total Marks	100%		

REFERENCE BOOKS

1. Introduction to Probability and Statistics for Engineers and Scientists‖ – By Sheldon M. Ross.
2. Advanced Engineering Mathematics -Michael D. Greenberg 2nd Edition.

5.3 General Education Courses

Bangladesh Studies

Spring Semester: L-1, T-I

COURSE INFORMATION			
Course Code Course Title	: GEBS 101 : Bangladesh Studies	Contact Hours Credit hours	: 2.00 : 2.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course has been designed for undergraduate engineering students to help them learn the rich history of Bangladesh, and to provide them with basic knowledge of historical events which eventually led to the formation of Bangladesh and constitution of Bangladesh, current trends in economic development, legislation, citizen charter, cultural aspects which will make them responsible citizen.			
OBJECTIVE			
1. To equip students with factual knowledge that will enable them to learn the history of Bangladesh. 2. To trace the historical roots of Bangladesh as an independent state focusing on the social, cultural and economic developments that have taken place since its independence. 3. To promote an understanding of the development of Bangladesh and its culture. 4. To create an awareness among the students about the Geography, Economy, Politics and Culture of Bangladesh.			
COURSE CONTENT			
a. Main Contents: Impact of Geography, History, Environment, Economy, Constitution and Culture of Bangladesh in Engineering Application b. c. Detail Contents: Bangladesh Geography: Location, Area, Boundary, Physiography, River system, Forest and Climate, Demography of Bangladesh, Maritime zones. History: Overview of the ancient Bengal, anthropological identity of the Bengali race, main trends in the history of medieval Bengal, Bengal under the East India Company, religious and social reform movements, nationalist movements, division of the Indian sub-continent, language movement 1948-1952, education movement of 1962, six-point movement of 1966, mass uprising of 1969, war of independence and emergence of Bangladesh in 1971, Constitution of Bangladesh, Pre and post liberation development in the field of engineering and technology, Bangladesh's contribution to world peace and its security, engineering developments in Bangladesh (Kaptai Dam, Padma bridge, power plants, Karnaphuli River Tunnel etc.) and its impact on socio-economic aspect. Environment, Economy and Culture : Land, Characteristics of tropical monsoon climate, Forests and biomass, Fish, Minerals, Health, Education, Agriculture, Industries, NGOs, Population, Sociological and Cultural aspects of			

Bangladesh, Economy and National development, Development and Progress of the Millennium Development Goals (MDGs), Public Administration in Bangladesh, State of Good Governance in Bangladesh, Art and Literature, Main traditional cultural events, Vision-2021, Digitalization, Tourism and Natural Resources, Bangladesh and International Relations.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Be able to **identify** specific stages of Bangladesh's political history, through the ancient, medieval, colonial and post-colonial periods and variety of cultural identities of Bangladesh.						√						
2	Be proficient to **explain** the economy and patterns of economic changes throughqualitative and quantitative analysis.						√						

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	Be able to **identify** specific stages of Bangladesh's political history, through the ancient, medieval, colonial and post- colonial periods and variety	6	C1, C2	-	-	7	Class Test/Mid Term Exam/Final Exam

	of cultural identities of Bangladesh.						
CO2	Be proficient to **explain** the economy and patterns of economic changes throughqualitative and quantitative analysis.	6	C2, C4	-	-	7	Class Test/Mid Term Exam/Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning	
Lecture (2 hours/week x 14 weeks)	28
Guided Learning	
Assignment Preparation	-
Independent Learning	
Individual learning	56
Preparation for quiz and final exam	14
Assessment	
Continuous assessment (Assignment/ Class Test)	01
Mid-Term	01
Final Exam	03
Total	103

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE		
Week	**Topics**	**Remarks**
1	Introductory class: Brief discussion on the totalsyllabus, basic requirements of the course, methods of assessment of the course. Bangladesh Geography: Location, Area, Boundary, Physiography, River System, Forest and Climate,Demography of Bangladesh.	CT-1
2	Overview of the ancient Bengal, anthropological identity of the Bengali race, main trends in the history of medieval Bengal, Bengal under the East India Company	
3	Religious and Social reform movements, Nationalist movements, Division of the Indian subcontinent	
4	Language movement 1948-1952, Education movement of 1962	Mid Term Exam
5	Six-point movement of 1966, Mass uprising of 1969, War of Independence and Emergence of Bangladesh in 1971	
6	Constitution of Bangladesh	
7	Bangladesh's contribution to world peace and security,Pre and post liberation development of engineering and technology.	
8	Land, Characteristics of tropical Monsoon climate, Forests and biomass, Fish Engineering development in Bangladesh (Kaptai Dam, Padma bridge, power plants, Karnaphuli RiverTunnel etc.) and its impact on socio-economic aspect	
9	Minerals, Health and Education, Agriculture, Industries	
10	NGOs, Population, Sociological and Cultural aspects of Bangladesh, Economy and national development	CT-2
11	Development and Progress of the Millennium, Development Goals (MDGs), Public Administration in Bangladesh, State of Governance in Bangladesh	
12	Art and Literature, Traditional cultural events	
13	Vision-2021, Digitalization, Tourism and Natural Resources	CT-3
14	Bangladesh and International Relations, Revisions	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Class Test/Class Assignment/Mid Term	40%	CO1, CO2	C1, C2
Final Exam	60%	CO1, CO2	C2, C4
Total Marks	100%		

REFERENCE BOOKS
1. Bangladesh Studies: Md. Shamsul Kabir Khan and Daulatunnahar Khanam 2. The Constitution of the People's Republic of Bangladesh 3. Discovery of Bangladesh: Akbar Ali Khan 4. History of Bangladesh, Vols, 1-3: Sirajul Islam 5. History of Modern Bengal, Vol, 1: R C Majumdar

Sociology

Fall Semester: Level 1 Term II

COURSE INFORMATION

Course Code Course Title	: GES 101 : Fundamentals of Sociology	Contact Hours Credit hours	: 2.00 : 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course has been designed to understand the human inter-personal relationship and human psychology in the society and to apply this knowledge in the practical field as an engineer through the study of varied societies and cultures.

OBJECTIVE

1. To equip students with factual knowledge that will enable them to understand the basic nature, scope, and perspective of sociology; the stages of the social research process, and methodologies.
2. To analyze different cultures and civilizations, and societal and cultural issues in national and global contexts.
3. To evaluate different social problems, economic life, and environmental issues for sustainable development.

COURSE CONTENT

a. Main Contents: Understanding society, social phenomena, and social change

b. Detail Contents: Nature and scope of Sociological imagination, Perspectives of sociology, Stages of social research and research method, Culture and civilization, Socialization and self-development, Globalization and social changes, Media and individual, Social organizations and social problems, social stratification, the industrial revolution, Capitalism and socialism, Work and economic life, Environment, and human activities, Climate change and global risk, Population and human society, Urbanization and city development, Social changes, and technology.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the basic nature, scope and perspective of sociology.						√						

2	**Apply** sociological-imagination to the context of social problems of BD society						√						
3	**Understand** the stages of social research processes and methodologies						√						
4	**Analyze** different cultures, civilizations, and different social problems and design solutions for those						√						
5	**Understand** social stratification, different social systems, socialism, capitalism and relate them to BD society						√						
6	**Understand** contextual knowledge to assess societal and cultural issues in an environmental context for sustainable development						√						

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the basic nature, scope, and perspectives of sociology	6	C1	-	-	7	Mid Term Exam
CO2	**Apply** sociological-imagination to the context of social problems of BD society	6	C3	-	-	7	Mid Term Exam
CO3	**Understand** the stages of social research processes and methodologies	6	C2	-	-	7	Final Exam
CO4	**Analyze** different cultures, civilizations, and different social problems and design solutions for those	6	C4	-	-	7	Mid Term Exam
CO5	**Understand** social stratification, different social systems, socialism, capitalism and relate them to BD society	6	C2	-	-	7	Final Exam
CO6	**Understand** contextual knowledge to assess societal and cultural	6	C2	-	-	7	Final Exam

	issues in an environmental context for sustainable development						

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning	
Lecture (2 hours/week x 14 weeks)	38
Guided Learning	
Assignment Preparation	-
Independent Learning	
Individual learning	18
Preparation for quiz and final exam	18
Assessment	
Continuous assessment (Assignment/ Class Test)	02
Mid-Term	01
Final Exam	03
Total	80

TEACHING METHODOLOGY

Lectures, class performances, assignments, class tests, final exam

TEACHING SCHEDULE

Week	**Topics**	**Remarks**
1	Definition, nature and scope of sociology, Sociological imagination	CT-1

2	Perspectives of sociology, Orientation of sociological theories	
3	Social research and its process, Research designs and techniques	
4	Introducing culture and its variations, civilization	
5	Defining family and its changes, Socialization process and development of self	
6	Introducing globalization and its impact on human life, Factors responsible to globalization	Mid Term
7	Media and its impact in modern society, Addressing social problems of Bangladesh	
8	Introducing social groups and organizations, Introducing bureaucracy and good governance	
9	Introducing social stratifications and social inequality, Poverty and its types and dimensions	CT-2
10	Industrial revolution and aftermath, Urbanization and city development	
11	Capitalism: features and influence, Socialism: features and influence	CT-3
12	Environment and human activities, Climate change and global risk	
13	Population of Bangladesh: problem or prospect, Crime and deviance: a brief analysis	
14	Review	

ASSESSMENT STRATEGY

Components	Grading	CO	Blooms Taxonomy
Class Test/Class Assignment/Mid Term	40%	CO1, CO2, CO3, CO4, CO5	C1, C2, C3, C4
Final Exam	60%	CO1, CO2, CO3, CO4, CO5, CO6	C1, C2, C3, C4
Total Marks	100%		

REFERENCE BOOKS

1. Sociology in Modules: by – Richard Schaefer, 2nd edition, 2013
2. Sociology - Primary Principles: by CN Shankar Rao
3. Anthony Giddens- 7th edition
4. Relevant journal

Principles of Accounting

Spring Semester: Level 2 Term I

COURSE INFORMATION			
Course Code Course Title	: GEA 201 : Principles of Accounting	Contact Hours Credit hours	: 2.00 : 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The purpose of this course is to serve as an introduction to basics of accounting, analysis, recording, summarizing and reporting.

OBJECTIVE

- Introduce fundamental principles and concepts of accounting, including the accounting equation and the double-entry bookkeeping system.
- Explain the preparation and interpretation of financial statements, such as Statement of Financial Position, Statement of Comprehensive Income, Statement of Changes in Equity.
- Develop a comprehensive understanding of cost accounting principles and concepts, including cost classification and cost behavior.
- Develop the competency to apply cost accounting tools to make informed business decisions, including Absorption costing and Variable costing, CVP Analysis, Job Order Costing and Process costing and Relevant Costing.

COURSE CONTENT

Accounting in Action; Recording Process; Adjusting the Accounts and prepare financial statement; Financial Statement Analysis; Computerized Accounting System; Cost Concepts; Absorption costing and Variable costing; Job Order Costing and Process Costing; Short & Long-Term Decision-Making in Accounting.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the fundamental principles of financial and cost accounting											√	
2	**Understand** financial reporting and analysis											√	

3	**Understand** cost behavior and cost control											√	
4	**Apply** cost accounting tools for making informed business decisions											√	

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the fundamental principles of financial and cost accounting	11	C2	-	-	1	Assignment, Final Exam
CO2	**Understand** financial reporting and analysis	11	C2	-	-	1	Mid- Term, Final Exam
CO3	**Understand** cost behavior and cost control	11	C2	-	-	1	Mid- Term, Final Exam
CO4	**Apply** cost accounting tools for making informed business decisions	11	C3	-	-	1	Assignment, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity **Bloom's Taxonomy Levels**: **C1**: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks)	 28
Guided Learning Assignment Preparation	 10
Independent Learning Individual learning Preparation for quiz and final exam	 24 13
Assessment Continuous assessment (Assignment/ Class Test) Mid-Term Final Exam	 01 01 03
Total	80

TEACHING METHODOLOGY

Lecture and Discussion

TEACHING SCHEDULE

Week	Topics	Remarks
1	Meaning, history and definition of accounting	Class Test, Final Exam
	The users and uses of accounting.	
2	Ethics in financial reporting	
	The cost principle, monetary unit assumption and the economic entity assumption	
3	Accounting equation and its components	Class Test, Final Exam
	The effects of business transactions on the accounting equation.	
4	Four financial statements and how they are prepared.	
	Journal	Mid Term, Final Exam
5	Journal	
	T-account, Ledger, Trial balance	
6	Adjusting Accounts	
	Worksheet.	

7	Completion of the Accounting cycle.	Class Test, Final Exam
	Financial Statement Analysis	
8	Managerial Accounting Basics	
	Cost Concepts	
9	Job Order Cost Accounting	
10	Process Cost Accounting	
11	Cost-Volume-Profit Relationships	
12	Performance	
13	Incremental Analysis	
14	Capital Budgeting	

ASSESSMENT STRATEGY

Components	Grading	CO	Blooms Taxonomy
Class Test/Class Assignment/Mid Term	40%	CO1, CO2, CO3	C2, C2, C3
Final Exam	60%	CO1, CO2, CO3, CO4	C2, C2, C3
Total Marks	100%		

REFERENCE BOOKS

1. Financial Accounting IFRS edition by Weygand, Kimmel & Kieso (3th).
2. Accounting Principles by Weygandt, Kieso & Kimmel (IFRS Latest edition.

Engineering Economics

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code Course Title	: GEE 201 : Engineering Economics	Contact Hours Credit Hours	: 2:00 : 2:00
PRE-REQUISITE			
N/A			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To learn the basic theories of economics in critical thinking and problem solving. To introduce the students to identify the basic features of economic development and regarding planning for the economy of the country.			

OBJECTIVE

- To help students demonstrate the knowledge of the fundamental concepts of economics.
- To teach how efficiency in organizational decision-making can be achieved.
- To help students understand consumer behavior, elasticity of market demand and different market structure.
- To help students realize the importance of various macroeconomic aggregates such as national income, full employment, unemployment, inflation, productivity and the major challenges associated with the measurement of these aggregates.
- To help students apply the basic theories of economics to make their project management cost-effective.
- To help students recognize the basic features of economic development and regarding planning for the economy of the country.

COURSE CONTENT

Main Contents	**Detail Contents**
Short History of the Evolution of Economics Thought	Definition of economics in various predominant schools of economics.
Consumer Theory	• Definition of Utility • Law of diminishing marginal utility. • Indifference Curve & MRS • Budget Line & Relative price • Consumer Equilibrium
Theory of Production	• Short-run VS Long-run production function • Stages of production in one-variable input production

	• Long-run production curve.	
Production Possibility Frontier	• PPF Curve. • Applying the PPF to Society's Choices by the Engineers.	
Demand & Supply	• Definition. • Law of Demand. • Law of Supply • Movement along the curve & Shift • Equilibrium analysis	
Elasticity of Demand	• Different types of elasticity. • Different types of price elasticity. • Relation between AR, MR and elasticity Mathematical Analysis	
Cost Analysis	• Determining, Average Cost (AC), Marginal Cost (MC) from Total Cost (TC) • Depreciation & Break-even point • Short-run cost analysis • Long-run cost analysis	
Analysis of Market Structure	• Perfectly Competitive Market • Monopoly and Monopolistic Market • Oligopoly (Cournot model & Stackelberg model)	
National Income	• Definition of GDP, GNP, NNP, NI • Three approaches GDP calculation. • Shortcoming of GDP calculation.	
Circular Flow of National Income	• Three sector Economy (Closed Economy) • Four Sector Economy (Open Economy)	
Inflation	• Inflation measuring indices • Calculation of GDP deflator & CPI • Demand-Pull and Cost-Push Inflation	
Money	• History of Money • Functions of Money • Fractional Reserve Banking	
Monetary policy	• Analysis of Financial Market • Monetary Policy Instruments	
Fiscal Policy	• Taxation Structures • Government Spending Multiplier • Tax Multiplier • Income Tax Calculation	
Exchange rate	• Definition & Calculation • How exchange rate impacts import & exports • Balance of Payment	
Unemployment	• Definition of terms related to unemployment. • Calculation of unemployment rate.	

	• Four fundamental types of unemployment. • Keynes Full Employment Theory • Analysis of labor market through various unemployment theories.
Engineering Economics	• Definition • Single Payment factor • Single Payment factor (Inflation & Tax Adjusted) • Uniform Series factor. • Gradient Series factor
Industrial Economics	• Economics of industrial revolution • Economics of union: Bargaining theories of wages

COURSE OUTCOME AND SKILL MAPPING

No.	COURSE OUTCOMES	PROGRAM OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Be able to **understand** the basic concepts and principles of microeconomics & macroeconomics.	√											
2	Be able to **apply** the basics of economics in optimization of a firm’s decision.	√											
3	Be able to **apply** the concepts of consumer behaviour, production process, cost of production and market structure to find the equilibrium that maximizes the welfare of the society.											√	
4	Be able to **interpret** the reasoning behind the economic policies of the government to develop the domestic economy as well as the relationship with the global economy.											√	

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
1	Be able to **understand** the basic concepts and principles of microeconomics and macroeconomics	1	C1	-	-	1	Mid Term, Final Exam
2	Be able to **apply** the basics of economics in optimization of a firm's decision.	1	C2	-	-	1	Mid Term, Final Exam
3	Be able to **apply** the concepts of consumer behavior, production process, cost of production and market structure to find the equilibrium that maximizes the welfare of the society.	11	C3	-	-	2	Mid Term, Final Exam
4	Be able to **interpret** the reasoning behind the economic policies of the government to develop the domestic economy as well as the relationship with the global economy.	11	C2	--	-	2	Mid Term, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	28
Self-Directed Learning	75
Formal Assessment	5.5
Total	**108.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topics	Assessments
1-4	Short History of the Evolution of Economics Thought, Importance of Economics in Engineering, National Income, Circular Flow of National Income, Consumer theory, Inflation, Money, Theory of Production, Monetary policy.	CT-1
5-7	Theory of Production, Fiscal Policy, Production Possibility Frontier, Demand & Supply, Exchange rate.	

	8-9	Demand & Supply, Elasticity of Demand, Unemployment	CT-2	
	10-12	Elasticity of Demand, Cost Analysis, Engineering Economics, Analysis of Market Structure		
	13	Analysis of Market Structure		
	14	Industrial Economics	MID	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Bloom's Taxonomy**
Continuous Assessment (Class Assignments/ Class Test/ Mid Term/)	40%	CO1, CO2, CO3, CO4	C1, C2, C3
Final Examination	60%	CO1, CO2, CO3, CO4	C1, C2, C3
Total Marks	100%		

REFERENCE BOOKS

1. Schaum's Outline of Microeconomics – McGraw-Hill by Dominick Salvatore (4rth Ed.)
2. Principle of Economics by N. Gregory Mankiw (8th Ed.)
3. Microeconomics by Robert S. Pindyck and Daniel L. Rubinfeld (8th Ed.)
4. Introduction to Macroeconomics with Applications to Bangladesh Economy by Kazi Iqbal & Amin Bin Hasib
5. Schaum's Outline of Macroeconomics – McGraw-Hill by Eugene A. Diulio (3rd Ed.)

Leadership and Management

Fall Semester: Level 1 Term II

COURSE INFORMATION			
Course Code Course Title	: GELM 175 : Leadership and Management	Contact Hours Credit hours	: 2.00 : 2.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The course is designed to make students understand the overlapping connection between engineering and management in an organization through the study of varied management practices and leadership traits as an engineer.			
OBJECTIVE			
• To introduce different management functions and approaches. • To expose students to different views and styles of leadership. • To understand how an organization functions collaboratively with managers and engineers. • To understand various personality traits and its impact on leadership and management to solve real-world management problems as an engineer.			
COURSE CONTENT			
a. Main Contents: Introduction to Leadership and Management, Management Fundamentals, Leadership & Motivation, Organizational Management, Planning and goal setting, Control, Change and Innovation, Attitude, Personality, Perception and Individual Decision Making, Understanding Work Team, HR Management, Operations Management, Information Technology and Management, Case studies. b. Detailed Contents: Introduction to Leadership and Management: Definition of leadership and management, basic difference between a leader and a manager, relation of leaders and managers with respect to efficiency and effectiveness, qualities of leader and managers with examples from history. Management Fundamentals: Definition of management & manager, levels of management, management functions and skills, Mintzberg's managerial roles, Henri Fayol's management principles, strategic management. Leadership & Motivation: Motivation, Maslow's hierarchy needs, theory of X & Y, motivators and hygiene factors, goal setting theory, reinforcement theory, equity theory, expectancy theory, Leadership styles, leadership trait theory, managerial grid, contemporary leadership, conflicts negotiation, leadership issues in 21st century, cross cultural leadership, engineer as a leader and some simple case discussions on leadership (positive and toxic leadership) in the class (Interactive Learning). Organizational Management: Organization, departmentalization, chain of command, unity of command, cross functional area, authority, centralization and decentralization, traditional &			

contemporary organization, matrix project structure, learning structure, organizing collaboration. Planning and goal setting: Foundation of planning, goals of plan, types of goal, types of goal & plan, goal setting, MBO, well written goal.

Control: Controlling process, controlling for organizational performance, types of control: (feed-forward, feedback & concurrent), balanced scorecard, contemporary issues in control, workplace concern & workplace violence.

Change and Innovation: Change and innovation, internal and external for change, changing process, creativity vs innovation. Attitude: Components of Attitude, behavior model and characteristics model, behavior vs. attitude, job attitude, job involvement, job satisfaction and customer satisfaction.

Personality: Personality determinants: heredity and environment, Myers-Briggs Type Indicator, Big five personality model, personality traits (core self-evaluation, Machiavellianism, narcissism, self-monitoring, risk taking, proactive personality).

Perception and Individual Decision Making: Factors influencing perception, attribution theory, errors/biases in attribution, Factors of individual decision making, rational decision making, bounded rationality, satisfice, common errors in decision making, creativity in decision making.

Understanding Work Team: Work group, work team, problem solving team, selfmanaged work team, cross functional team, virtual team, team effectiveness, team challenges.

HR Management: Process of Human Resource Planning, forecasting demand for labor, staffing, internal supply of labor, performance appraisal.

Operations Management: Project managing basics, goals and boundary of project,WBS, scheduling a project, Demand and supply forecasting, inventory control.Information

Technology and Management: Management Information System (MIS), Enterprise Resource Planning (ERP) - For introductory knowledge.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the fundamental concepts of leadership and management skills									√			
2	**Apply** the role and contribution of a leader in achieving organizational goals.									√			

3	**Understand** the contribution of leadership traits and management skills in decision making and solving real life problems.									√			

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the fundamental concepts of leadershipand management skills	9	C2	-	-	1	Final Exam
CO2	**Apply** the role and contribution of a leader inachieving organizational goals.	9	C3	-	-	1	Mid Term Exam, Final Exam
CO3	**Understand** the contribution of leadership traits and management skills in decision making and solving real life problems.	9	C2	-	-	1	Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks)	 28
Guided Learning Assignment Preparation	 -
Independent Learning Individual learning Preparation for quiz and final exam	 24 14
Assessment Continuous assessment (Assignment/ Class Test) Mid-Term Final Exam	 01 01 03
Total	103

TEACHING METHODOLOGY

Lecture and Discussion

TEACHING SCHEDULE

Week	Topics	Remarks
1	Introduction to Leadership and Management: Definition of leadership and management; basic difference between a leader and a manager; relation of leaders and managers with respect to efficiency and effectiveness; qualities of leader and managers with examples from history.	CT 1
	Management Fundamentals: Definition of management & manager; levels of management; management functions and skills; Mintzberg's managerial roles; Henri Fayol's management principles; strategic management.	
2	Leadership & Motivation: Motivation, Maslow's hierarchy needs; theory of X & Y; motivators and hygiene factors; goal setting theory; reinforcement theory; equity theory; expectancy theory	
3	Leadership: Leadership styles; leadership trait theory; managerial grid; contemporary leadership; conflicts negotiation; leadership issues in 21st century; cross cultural leadership; engineer as a leader and some simple case discussions on leadership (positive and toxic leadership) in the class (Interactive Learning).	

4	Case Study – I: Engineer as Great Leaders	
5	Organizational Management: Organization; departmentalization; chain of command; unity of command; cross functional area; authority; centralization and decentralization; traditional & contemporary organization; matrix project structure; learning structure; organizing collaboration.	
	Planning and goal setting: Foundation of planning; goals of plan; types of goal; types of goal & plan; goal setting; MBO; well written goal.	
6	Control: Controlling process; controlling for organizational performance; types of control: (feed-forward, feedback & concurrent); balanced scorecard; contemporary issues in control; workplace concern & workplace violence.	
	Change and Innovation: Change and innovation; internal and external for change; changing process; creativity vs innovation.	
7	Case Study – II: Planning and Goal Setting; A Managerial Approach: Engineer as Great Managers (Interactive Discussions in the Class)	
	Attitude: Components of Attitude; behavior model and characteristics model; behavior vs. attitude; job attitude; job involvement; job satisfaction and customer satisfaction.	
8	Personality: Personality determinants: heredity and environment; Myers-Briggs Type Indicator; Big five personality model; personality traits (core self-evaluation, Machiavellianism, narcissism, self-monitoring, risk taking, proactive personality).	Mid Term/ Project
	Perception and Individual Decision Making: Factors influencing perception; attribution theory; errors/biases in attribution	
9	Perception and Individual Decision Making: Factors of individual decision making; rational decision making; bounded rationality; satisfice; common errors in decision making; creativity in decision making.	
	Case Study – III: A Case on Decision Making – Involves both leadership and managerial skills (Interactive Discussion in the Class)	
10	Understanding Work Team: Work group; work team; problem solving team; self-managed work team; cross functional team; virtual team; team effectiveness; team challenges.	CT 2
	HR Management: Process of Human Resource Planning; forecasting demand for labor; staffing.	
11	HR Management: Internal supply of labor; performance appraisal.	
	Operations Management: Project managing basics; goals and boundary of project; WBS; scheduling a project.	
12	Operations Management: Demand and supply forecasting; inventory control.	
	Exercise – Use of Microsoft Project (MSP) for scheduling a project at student level	
13	Case Study – IV: A case that covers all relevant theories taught throughout the course and involves both leadership and management	

	issues, e.g., Columbia's Final Mission. (This may be given as group assignment followed by in class short presentations/discussions)	
14	Information Technology and Management: Management Information System (MIS); Enterprise Resource Planning (ERP) - For introductory knowledge.	
	Revision	

ASSESSMENT STRATEGY

Components	Grading	CO	Blooms Taxonomy
Class Test/Class Assignment/Mid Term	40%	CO1, CO2, CO3	C2, C3
Final Exam	60%	CO1, CO2, CO3	C2, C3
Total Marks	100%		

REFERENCE BOOKS

1. Engineering Management (Revised Edition) – A.K. Gupta.
2. Industrial Engineering and Production Management - Martand T. Telsang.
3. Leadership in Organizations – Gary Yukl.
4. Developing Management Skills – David A. Whetten and Kim S. Cameron.

Sustainability of Development Projects

Spring Semester L-3, T-I

COURSE INFORMATION			
Course Code Course Title	: GESP 303 : Sustainability of Development Projects	Contact Hours Credit hours	: 2 hrs/week : 2.00

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
In this course students will learn the different aspects associated with development projects, social and environmental sustainability, development index, planning and policy towards development in Bangladesh, and socio-economic impact assessment approach.

OBJECTIVE
• Gain a fundamental understanding of the concepts of socio-economic aspects of development projects. • Learn fundamental principles of environment and sustainable development, sustainable development goals (SDGs), development and economic growth, socio-economic indicators, and development index. • Understand the concepts of human-interest related aspects, population displacement, resettlement and rehabilitation strategy, socio-economic impact assessment approach. • Gather knowledge on planning and policies regarding development processes in Bangladesh.

COURSE CONTENT
Environment and sustainable development; sustainable development goals (SDGs); economics and social structure; development and economic growth; socio-economic indicators; concept of human development, human development index; gender related human development index; human poverty and human poverty index; poverty reduction strategies in Bangladesh. Socio-economic aspects of development projects; human interest related aspects; land use, land acquisition policy in Bangladesh; planning processes in Bangladesh; responsibilities in overall socio-economic development in Bangladesh; population displacement; resettlement and rehabilitation strategy; inequalities in distribution of benefits and losses; community participation in development project. Socio-economic impact assessment approach (both Bangladesh and international standard); socio-economic survey; case studies.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

1	Demonstrate various socio-economic indicators of developments with reference to Bangladesh.						√						
2	Comprehend the concept of sustainable development, SDG, and interpret the uniqueness of development projects in different economic and social structure.							√					
3	Identify focal socioeconomic and environmental issues and dimensions related to development projects and evaluate their impact on society.						√						

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	Demonstrate various socio-economic indicators of developments with reference to Bangladesh.	PO6	C2			4,5	Class Test, Assignments, Mid-term, Final Exam
CO2	Comprehend the concept of sustainable development,	PO7	C3	1,2,3		5,6	

	SDG, and interpret the uniqueness of development projects in different economic and social structure.						
CO3	Identify focal socioeconomic and environmental issues and dimensions related to development projects and evaluate their impact on society.	PO6	C5			6,7	

<u>Knowledge Profile (K)</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

<u>Complex Engineering Problem (P)</u>:

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

<u>Complex Engineering Activities (A)</u>:

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

<u>Bloom's Taxonomy Levels</u>:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	22 15
Assessment Continuous Assessment Final examination	2 3

Total	80
TEACHING METHODOLOGY	
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)	
TEACHING SCHEDULE	

Week	**Lectures**	**Topics**	**Assessments**
1	1	Introduction, Economic and Social structure	CT/Assignment/ Mid Term/Final Exam
	2	Development Concept	
2	3	Introduction, Economic and Social structure	
	4	Development Indicator	
3	5	Development Project	
	6	Development Indicator	
4	7	7th Five year Plan	
	8	Sustainable Development	
5	9	Resettlement issue	
	10	Sustainable Development	
6	11	Resettlement issue	CT/Assignment/ Mid Term/Final Exam
	12	Millennium Development Goals (MDGs)	
7	13	Community Participation	
	14	Millennium Development Goals (MDGs)	
8	15	WSS issue	
	16	Millennium Development Goals (MDGs) and Bangladesh	
9	17	Impact of project	
	18	Millennium Development Goals (MDGs) and Bangladesh	
10	19	Impact of project	
	20	Sustainable Development Goals (SDGs)	
11	21	Quality of Life	
	22	Sustainable Development Goals (SDGs) and Status of Bangladesh	
12	23	SIA Variable	CT/Assignment/ Mid Term/Final Exam
	24	SDGs and Important Targets	
13	25	Case Study	

	26	Bangladesh's Socioeconomic Success	
14	27	Case Study and Revision	
	28	Revision	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C2, C3, C5
Final Exam	60%	CO1, CO2, CO3	C2, C3, C5
Total Marks	100%	CO1, CO2, CO3	C2, C3, C5

REFERENCE BOOKS

1. Project Planning and Control' by Lester
2. 'Project Management Techniques' by A.O. Awani
3. Vanclay (2015) Social Impact Assessment – Guidance for Assessing and Managing the impacts of Projects, International Association for Impact Assessment
4. Development Project Proforma/Proposal (DPP) Manual (Parts 1 and 2), General Economics Division (GED), Planning Commission, Ministry of Planning, Government of the People's Republic of Bangladesh, March 2014
5. Salim Momtaz, "Social Impact Assessment in Bangladesh: A Critical Review of the Recent Developments".

Project Planning and Construction Management

Fall Semester: L-4, T-II

COURSE INFORMATION			
Course Code Course Title	: GEPM 401 : Project Planning and Construction Management	Contact HoursCredit hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course provides knowledge on principles of project management, human resource management, project planning. It is design to develop skills to perform project scheduling, project appraisals, resource allocation by operation research technique which will be useful in in their professional life.			
OBJECTIVE			
• To gain knowledge on principles of project management & organizations, conflict management, human resource management, inventory management, demand forecasting and construction site management • To develop skills for evaluating a project based on BCR, NPV, IRR, PBP • To execute allocation of resources by linear programming and plan a project by network techniques and project management software			
COURSE CONTENT			
Project Planning: project planning and evaluation; Planning and scheduling, PERT, CPM; resource scheduling; Project management software; linear programming and application; feasibility reports Construction Management: Principles of management; Construction management: principles, project organization, methods and practices, technology, management of materials and equipment, site management, contracts and specifications, inspection and quality control, safety, economy. Conflict management; Psychology in administration: human factors in management; human resource management. Demand forecasting; inventory control; stores management; procurement; legal issues in construction. Time value of money, cash flows, payback period, net present value, internal rate of return, fisher's rate of intersection, benefit-cost ratio, cost-benefit analysis case studies.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Explain** the principles of project management &organizations, human resource management, inventory management, demandforecasting and construction site management	√											
2	**Plan** a projectschedule by network techniques and projectmanagement softwareand **execute** allocationof resources by linear programming			√									
3	**Apprise** a project based on BCR, NPV, IRR, PBP.				√								

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	**Explain** the principles of project management & organizations, human resource management, inventory management, demand forecasting and construction site management	1	3	-	-	3	Class Test, Assignment, Mid-term, Pop quiz, Final Exam

CO2	**Plan** a project schedule by network techniques and projectmanagement software and **execute** allocationof resources by linear programming	3	4	-	-	4	Class Test, Assignment, Mid-term, Pop quiz, Final Exam
CO3	**Apprise** aproject based on BCR, NPV, IRR, PBP	4	5	-	-	4	Class Test, Assignment, Mid-term, Pop quiz, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	15
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	36 22
Assessment Continuous examination Final Assessment	2 3
Total	120

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning(PBL)

TEACHING SCHEDULE		
Week	**Topics**	**Assessments**
1	Definition and characteristics of a project	CT/ Assignment
	Principles of Project Management	
	Principles of Project Management	
2	Feasibility study, feasibility report	
	Introduction to Construction Planning and Management	
	Project Organization: Methods and Practices, Technology	
3	Project life, time value of money, compounding and discounting formulas	
	Project Organization: Methods and Practices, Technology	
	Project Team	
4	PBP, NPB	CT/ Assignment
	Project Leadership	
	Motivation	
5	BCR, IRR	
	Project Communication	
	Management of Materials and Equipment	
6	Project planning, WBS, network technique	Mid Term/ Assignment
	Site Management	
	Contracts and Specifications	
7	CPM, Project Planning software	
	Illustrative example with CPM, Project Planning software	
	Inspection and Quality Control	
8	PERT	
	Illustrative example with PERT	
	Safety	
9	Crashing and network to find the optimum duration	
	Illustrative example for crashing a network	
	Economy	
10	Introduction to Linear Programing, formulation of objectivefunction, constraint equations	
	Graphical solution of linear programming	
	Project Risk management	
11	Illustrative examples of graphical methods	
	Illustrative examples of graphical methods	
	Project Risk management	
12	Inventory management	CT/ Assignment
	EOQ	

	Conflict Management	
13	Demand Forecasting	
	Methods of Demand Forecasting	
	Psychology in Administration	
14	Construction safety, ethics, procurement	
	Human Factors in Management	
	Human Resource Management	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ ActiveClass Participation)	40%	CO1, CO2, CO3	3,4,5
Final Exam	60%	CO 1	3
		CO 2	4
		CO 3	5
Total Marks	100%		

REFERENCE BOOKS

1. Project Planning and Control by -Lester
2. The Process of Management” by – William H. Newman
3. Introduction to Operational Research by – Hiller &Liberman
4. Project Management Techniques by – A.O.
5. Construction Planning, Equipment and Methods by – Peurifoy
6. Material Management & Inventory Control by – A.K. Datta
7. Project Management by – S. Chowdhury

COURSE INFORMATION			
Course CodeCourse Title	: GERM 352 : Fundamentals of Research Methodology	Contact HoursCredit Hours	: 2.00 : 1.00

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
The Fundamentals of Research Methodology is a hands-on course designed to impart educationin the foundational methods and techniques of academic research in Science and Engineering context. UG students would examine and be practically exposed to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, time management, report writing, and presentation. Once equipped with this knowledge, participants would be well-placed to conduct disciplined research under supervisionin an area of their choosing. In addition to their application in an academic setting, many of themethodologies discussed in this course would be similar to those deployed in professional research environments.

OBJECTIVES

- To evaluate/review related extant literature, form a variety of sources, pertinent to theresearch objectives/questions.
- To expose students to various research methodologies (design), relevant to the researchproblem needing to be addressed.
- To explain and justify how researchers will collect and analyze research data.
- To educate students in the common mistakes, research misconduct, and ethicalconsiderations in the field of research methodology.

COURSE CONTENT
Foundations of Research, Problem Identification and Formulation, Research Design, Data Analysis, Research Misconduct and Ethics, Use of Tools/Techniques for Research, Timemanagement skills and developing Gantt Chart for proper planning and execution of research work.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the research fundamentals and **formulate** problem statement and research questions/objectives.		√										

2	**Formulate** and **compose** a Research proposal considering research activities, background studies, and following standard guidelines.												√
3	**Develop** writing and presentation skill, and **demonstrate** ethical considerations in conducting research.										√		

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** theresearch fundamentalsand **formulate** problem statement and research questions/objectives.	2	C2	-		4,6	Assignment, Class Test
CO2	**Formulate** and**compose** a researchproposal considering research activities/design, background studies, and followingstandard guidelines.	12	C3	-		4,7,8	Report, Project, Assignment, Class Test
CO3	**Develop** writing and presentation skill, and **demonstrate** ethical considerations inconducting research.	10	C3	-		3	Report, Project, Assignment

<u>Knowledge Profile (K)</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

<u>Complex Engineering Problem (P)</u>:

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture Practical / Tutorial / StudioStudent- Centered Learning	- 24 12 12
Guided Learning Assignment Preparation	- -
Independent Learning Individual learning Preparation for Report	- 12 18
Assessment Continuous assessmentReport Submission Presentation	 1.5 - 0.5
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning(PBL), Mini-Seminars by Experts

TEACHING SCHEDULE

Week	Topics	Remarks
1	Foundations of Research: Meaning of Research; Definitions of Research; Objectives of Research; Motivation in Research; General Characteristics of Research; Criteria of Good Research; Types of Research; Concept of theory, empiricism, deductive and inductive theory; Characteristics of scientific method.	
2	Practice session on Foundations of Research	
3	Problem Identification & Formulation: Meaning & need of Review of Literature; How to Conduct the Review of literature; Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis – Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.	Continuo us Assessme nt (presentat

4	Practice session on Problem Identification & Formulation	ion/ quiz/other assignment)
5	Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.	
6	Practice session on Research Design	Assignment 1, Presentation
7	Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts,percentages), Bivariate analysis – Cross tabulations and Chi-square test including testinghypothesis of association.	
8	Practice session on Data Analysis	
9	Research Misconduct and Ethics: Understand the research misconduct; type of research misconduct; Ethical issues inconducting research; Ethical issues related to publishing, Plagiarism and Self-Plagiarism.	
10	Practice session on Research misconduct and Ethics	Continuous Assessment (presentation/ quiz/other assignment)
11	Use of Tools / Techniques for Research: Layout of a Research Paper; Methods to search required information effectively; Reference Management Software like Zotero/Mendeley; Software for paper formatting like LaTeX/MS Office; Software for detection of Plagiarism. Time management and developing Gantt Charts.	
12	Practice session on Use of tools / techniques for Research	
13	Review Session (Theory) – I /Final Presentation	Assignment 2, Presentation
14	Review Session (Practice) – II /Final Presentation	

ASSESSMENT STRATEGY

Components	Grading	CO	Blooms Taxonomy
Assignment I	20%	CO1, CO3	C2, C3
Assignment II	40%	CO2, CO3	C2, C3
Continuous Assessment	40%	CO1, CO2	C2, C3
Total Marks	100%		

REFERENCE BOOKS
1. Engineering Research Methodology: A Practical Insight for Researchers. Springer, by Deb,Dipankar, Dey, Rajeeb, Balas, Valentina E. 2. Research Methods for Engineers, 1st Edition, by David V. Thiel. 3. Handbook of Research Methodology by Talati, J.K. 4. Introducing Research Methodology: A Beginner′s Guide to Doing a Research Project byUwe Flick 5. Research Methods: Information, Systems, and Contexts by Kirsty Williamson, GraemeJohanson 6. Improving survey questions: design and evaluation. Sage Publications, by Fowler, F. J. 7. Computational handbook of statistics (4th ed.). New York: Longman, by Bruning, J. L. &Kintz, B. L.

5.4 Language

Communicative English I

Fall semester: L-1 T-II

COURSE INFORMATION			
Course Code Course Title	: LANG 102 : Communicative English -I	Contact Hours Credit Hours	: 3.00 : 1.50
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The English language course is designed for the students to develop their competence in communication skills for academic purposes emphasizing speaking, reading, listening and writing. The approach will be communicative and interactive and will involve individual, pair and group work. Students will be exposed to diverse text types to refine their reading skills, engaging in activities and discussions that foster effective writing type. The course incorporates a wide range of reading texts to develop students' critical thinking which is one of the most essential elements required to write a good piece of academic writing. Special emphasis is placed on the various forms of essay including descriptive, narrative, cause-effect, compare-contrast, and argumentative. Upon completion of this course, student should demonstrate proficiency in communication across diverse contexts, engage in group activities, and deliver formal speech for academic, professional and social purposes. This course also incorporates classroom instructions to provide guidelines on presentations and communication skills. Additionally, the course emphasizes providing constructive feedback on students' oral performances.			
OBJECTIVES			
1. To develop the four basics skills of English language, i.e. listening, speaking, reading and writing. 2. To enhance students' interpersonal skills through participation in various group interactions and activities. 3. To improve students' pronunciation to enhance comprehensibility in both speaking and listening. 4. To gain proficiency in crafting well- organized paragraphs and learn to edit and revise both their own as well as peer's writing.			
COURSE CONTENT			
Speaking: Introduction to Language: Introducing basic skills of language. English for Science and Technology Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd. Name, family background, education, experience, any special quality/interest, likings/disliking, etc. Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions Discussing everyday routines and habits, Making requests/offers/invitations/excuses/apologies/complaints Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event Practicing storytelling, Narrating personal experiences/Anecdotes Telephone conversations (role play in group or pair) Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher –student conversation)			

Listening: Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand; Listening to short conversations between two persons/more than two.

Reading: Reading techniques: scanning, skimming, predicting, inference; Reading Techniques: analysis, summarizing and interpretation of texts.

Writing: Introductory discussion on writing, prewriting, drafting; Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event Paragraph writing, Compare-contrast and cause- effect paragraph.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Communicate** in English quickly and smartly using the techniques learnt in the class.	✓											
2	**Understand** the techniques of academic reading and writing	✓											
3	**Communicate** ideas and opinions effectively within the shortest possible time										✓		
4	**Excel** in oral and written communication/ Presentation competency										✓		

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods

1	**Communicate** in English quickly and smartly using the techniques learnt in the class.	1	C2	-	-	1	Assignment, Quiz
2	**Understand** the Techniques of academic reading and writing	1	C3	-	-	1	Project/ Assignment , Quiz
3	**Communicate** ideas and opinions effectively within the shortest possible time	10	C4	-	-	1	Project, Assignment, Quiz
4	**Excel** in oral and written communication/ Presentation competency	10	C5	-	-	2	Project/ Assignment , Quiz

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning	
Lecture	-
Practical / Tutorial / Studio	4
Student-Centered Learning	2
	42
Guided Learning	30
Assignment Preparation	-
Independent Learning	
Individual learning Preparation	-
for Report	-
Assessment	

Continuous assessment (Descriptive writing Reading Test, Listening Test, Public Speaking) Report Submission Presentation	04 - -
Total	88

TEACHING METHODOLOGY

Lecture and Discussion, Tutorial, Assignment, Report

TEACHING SCHEDULE

Week	Topics	Remarks
1	Introduction to Language: Introducing basic skills of language; English for Science and Technology	Assignment, Project, Quiz
	Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd; Name, family background, education, experience, any special quality/interest, likings/disliking, etc.	
	Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd; Name, family background, education, experience, any special quality/interest, likings/disliking, etc.	
2	Asking and answering questions, expressing likings and disliking; (food, fashion etc.) Asking and giving directions	
3	Discussing everyday routines and habits, making requests/ offers/ invitations/ excuses/ apologies/ complaints	
4	Describing personality, discussing and making plans (for a holiday or an outing to the cinema), Describing pictures / any incident / event	
5	Practicing storytelling, Narrating personal experiences/Anecdotes	
6	Telephone conversations (role play in group or pair); Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher–student conversation)	
7	Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions	
8	Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand	
9	Listening to short conversations between two persons/more than two	
10	Reading techniques: scanning, skimming, predicting, inference;	
11	Reading techniques: scanning, skimming, predicting, inference;	
12	Introductory discussion on writing, prewriting, drafting;	
13	Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event	

14	Paragraph writing, Compare-contrast and cause- effect paragraph	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Compulsory) Descriptive writing Reading Test Listening Test Public Speaking	 20% 15% 15% 20%	CO1, CO2, CO3, CO4	C2, C3, C4, C5
Group Presentation	30%	CO1, CO2, CO3, CO4	C2, C3, C4, C5
Total Marks	100%		

REFERENCE BOOKS

1. Langan, J. (2005). College Writing Skills with Readings (6th Ed). McGraw-Hill Publication.
2. Interactions 1 (Reading), John Langan, Latest edition, McGraw-Hill Publication
3. Jones, L. (1981). Functions of English. (Student's Book, 2nd Ed.) Melbourne, Australia: Cambridge University Press.
4. Dixon, R.J. (1987). Complete course in English. (Book 4). New Delhi, India: Prentice Hall of India. (For book presentation).
5. From Paragraph to Essay - Maurice Imhoof and Herman Hudson Headway Series – Advanced Level (2 parts with CDs): Oxford University Press Ltd.

Communicative English -II

Spring semester: L-2 T-I

COURSE INFORMATION			
Course Code	: LANG 202	Contact Hours	: 3.00
Course Title	: Communicative English -II	Credit Hours	: 1.50
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The English language course is designed for the students to develop their competence in communication skills for academic purposes emphasizing speaking, reading, listening and writing. The approach will be communicative and interactive and will involve individual, pair and group work. Students will be exposed to diverse text types to refine their reading skills, engaging in activities and discussions that foster effective writing type. The course incorporates a wide range of reading texts to develop students' critical thinking which is one of the most essential elements required to write a good piece of academic writing. Special emphasis is placed on the various forms of essay including descriptive, narrative, cause-effect, compare-contrast, and argumentative. Upon completion of this course, student should demonstrate proficiency in communication across diverse contexts, engage in group activities, and deliver formal speech for academic, professional and social purposes. This course also incorporates classroom instructions to provide guidelines on presentations and communication skills. Additionally, the course emphasizes providing constructive feedback on students' oral performances.			
OBJECTIVES			
1. To develop English language skills to communicate effectively and professionally. 2. To strengthen students' presentation skills. 3. To develop competency in academic reading and writing.			
COURSE CONTENT			
Reading: Reading Comprehension: Practice using different techniques Academic reading: comprehension from departmental or subject related passages; Vocabulary for Engineers (some common Engineering terms for both general and dept specific); Reading subject specific text to develop vocabulary **Writing:** Writing semi-formal, Formal/official letters, Official E-mail Applying for a job: Writing Cover Letter and Curriculum Vitae; Essay writing: writing steps, principles and techniques, outlining, revising, editing, proofreading; Narrative and descriptive writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing; Analyzing and describing graphs or charts; Practicing analytical and argumentative writing **Speaking:** Public Speaking: Basic elements and qualities of a good public speaker; Set Speech and Extempore Speech: How to get ready for any speech – set or extempore. Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing power point slides, etc. Selected books/Selected stories for presentation. **Listening:** Listening to long lecture on some topics, Listening and understanding speeches/lectures of different accent.			

COURSE OUTCOMES AND SKILL MAPPING													
No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the techniques of academic reading and become familiar with technical vocabularies.	✓											
2	**Understand** the techniques of effective academic writing including research article/report writing.	✓											
3	**Communicate** effectively to present their reports and research work within the shortest possible time										✓		
4	**Analyze** any problem critically, interpret data and synthesize information to provide valid conclusions.										✓		

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
1	**Understand** the techniques of academic reading and become familiar with technical vocabularies.	1	C2	-	-	1	Assignment, Quiz
2	**Understand** the techniques of effective academic writing including research article/report writing.	1	C3	-	-	1	Project/ Assignment, Quiz

3	**Communicate** effectively to present their reports and research work within the shortest possible time	10	C4	-	-	1	Project, Assignment, Quiz
4	**Analyze** any problem critically, interpret data and synthesize information to provide valid conclusions.	10	C5	-	-	2	Project/ Assignment, Quiz

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture Practical / Tutorial / Studio Student-Centered Learning	- 42 42
Guided Learning Assignment Preparation	30 -
Independent Learning Individual learning Preparation for Report	- -
Assessment Continuous assessment (Writing Test Reading Test Listening Test Public Speaking) Report Submission Presentation	04 - -
Total	88

TEACHING METHODOLOGY
Lecture and Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Topics	Remarks
1	Reading Comprehension: Practice using different techniques	Assignment, Project, Quiz
2	Academic reading: comprehension from departmental or subject related passages	
3	Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary	
4	Writing semi-formal, Formal/official letters, Official E-mail	
5	Applying for a job: Writing Cover Letter and Curriculum Vitae Practicing storytelling, Narrating personal experiences/Anecdotes	
6	Essay writing: writing steps, principles and techniques, outlining, revising, editing, proofreading;	
7	Narrative and descriptive writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing;	
8	Analyzing and describing graphs or charts	
9	Practicing analytical and argumentative writing	
10	Public Speaking: Basic elements and qualities of a good public speaker	
11	Set Speech and Extempore Speech: How to get ready for any speech – set or extempore.	
12	Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing power point slides, etc. Selected books/Selected stories for presentation.	
13	Listening to long lecture on some topics	
14	Listening and understanding speeches/lectures of different accents	

ASSESSMENT STRATEGY

Components	Grading	CO	Blooms Taxonomy
Continuous Assessment (Compulsory) Descriptive writing Reading Test Listening Test Public Speaking	 20% 15% 15% 20%	CO1, CO2, CO3, CO4	C2, C3, C4, C5

Group Presentation	30%	CO1, CO2, CO3, CO4	C2, C3, C4, C5
Total Marks	100%		

REFERENCE BOOKS

1. Jones, L. (1981). Functions of English. (Student's Book, 2nd Ed.) Melbourne, Australia: Cambridge University Press.
2. Dixon, R.J. (1987). Complete course in English. (Book 4). New Delhi, India: Prentice Hall of India. (For book presentation).
3. Langan, J. (2005). College Writing Skills with Readings (6th Ed). McGraw-Hill Publication.
4. Interactions 1 (Reading), John Langan, Latest edition, McGraw-Hill Publication.
5. Headway Series – Advanced Level (2 parts with CDs): Oxford University Press Ltd.
6. Speak like Churchill stand like Lincoln - James C. Humes.
7. Cambridge IELTS Practice Book h. Selected Sample Reports and Selected Research Articles.

5.5 Interdisciplinary Courses (EECE, PME, CSE, ARCH)

Basic Electrical Engineering offered by EECE Department

Fall semester: L-I T-1

COURSE INFORMATION			
Course Code	: EECE 165	Lecture Contact Hours	: 3.00
Course Title	: Basic Electrical Technology	Credit Hours	: 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To introduce the students with the fundamental concepts of DC and AC circuits, relevant components and theorems. The course is designed to give a brief introduction on the basics of network analysis of electrical and electronic circuits, electronic devices and electrical machines. It aims to build a strong foundation on electrical wiring system with a view to enabling the students to work efficiently in practical field and design efficient layouts for electrical wiring.			
OBJECTIVES			
• To familiarize the students with the basics of DC and AC circuit analysis. • To impart knowledge on the working principle and applications of some common yet frequently used electronic devices. • To introduce the students with the electrical machines that are in use enabling them to analyses the characteristics of the machines changing relevant parameters. • To ensure that the students have the necessary knowledge of Electrical Wiring system to work efficiently in practical field.			
COURSE CONTENT			
Measurement of electrical quantities: Current, voltage, resistance, **Measuring instruments**: Ammeter, voltmeter, watt meter and multimeter, **Laws of Electric Circuit:** Ohm's law, Kirchhoff's voltage and current laws, Series, parallel equivalent circuit and Delta-wye transformation. **Electrical networks analysis:** Branch and loop currents, node and mesh current analysis, Super position, Thevenin's and Norton's theorem, **AC circuit analysis**: Instantaneous current, voltage and power, effective current and voltage, average power. **Introduction to Electronics devices with simple application:** Diodes, Rectifiers. Familiarization with different types of electrical machines: DC generators and motors, alternators, AC motors, transformers. Working principles of transformers and induction motors.			

Electrical Wiring: Rules and Regulations, wiring for residential, industrial, commercial buildings, cost estimation for electrical wiring, illumination.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Be able to **apply** the concepts of DC and AC circuit analysis for solving relevant problems.	√											
2	Be able to **explain** the working principles of commonly used electrical machines and solve problems.	√											
3	Be able to **analyze** potential solution using network theorem.	√											
4	Be able to **design** efficient layouts for the wiring system of residential, commercial and industrial buildings.			√									

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	CP(WP)	CA(EA)	KP(WK)	Assessment Methods
CO1	Be able to **apply** the concepts of DC and AC circuit analysis for solving relevant problems.	PO1	C4	1	-	3	Class Test, Assignment, Final Exam
CO2	Be able to **explain** the working	PO1	C3	1	-	3	Mid Term/ Final Exam

	principles of commonly used electrical machines and solve problems.						
CO3	Be able to **analyze** potential solution using network theorem.	PO1	C2	-	-	3	Mid Term/ Final Exam
CO4	Be able to **design** efficient layouts for the wiring system of residential, commercial and industrial buildings.	PO3	C3	P2	-	5	Mid Term/ Project/ Final Exam

WP= Washington Accord Complex Problem Solving/ CP= Complex Problem Solving; EA= Engineering Activities/ CA= Complex Activities; WK= Washington Accord Knowledge Profile/ KP= Knowledge Profile

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture Practical / Tutorial / Studio	42
Guided Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	42 21 21
Assessment Continuous assessment Final Quiz	2 3
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion.

TEACHING SCHEDULE		
Week 1	**Topics**	**Assessment**
Class 1	Electricity, Electric element and components, Electric Circuit, Current (AC or DC), Voltage.	Class Test, Final Exam
Class 2	Power and energy, Active elements, Passive elements, Independent and Dependent source	
Class 3	Ohm’s law, Resistor, Conductor, Insulator, Semi-conductor, Branch, Node, Loop, Mesh	
Week 2		
Class 4	Series-parallel connection	
Class 5	KCL, KVL, Analysis of equivalent resistance of electrical circuit	
Class 6	Analysis of voltage, current and power	
Week 3		
Class 7	Y to Δ conversion derivation	
Class 8	Analysis of electrical circuits with Y-Δ connection	
Class 9	Ammeter, Voltmeter, Wattmeter and Multimeter	
Week 4		Mid Term
Class 10	Su er node analysis	
Class 11	Various mathematical problems solving nodal analysis	
Class 12	Mesh Analysis	
Week 5		
Class 13	Network Theorems	
Class 14	Network Theorems	
Class 15	Magnetic Circuits	
Week 6		
Class 16	Introduction to AC, Reactive circuit components	
Class 17	Network theorems for AC circuit analysis	
Class 18	Network theorems for AC circuit analysis	
Week 7		
Class 19	Average and RMS values of current, voltage and power	
Class 20	Instantaneous Current, voltage and power for RC and RL circuits	
Class 21	Instantaneous Current, voltage and power for RLC circuits	
Week 8		Class Test, Final Exam
Class 22	Diode (Working principle)	
Class 23	Diode (Applications and mathematical problems)	
Class 24	Transistor	
Week 9		
Class 25	Transformer	
Class 26	DC generator	

Class 27	DC generator, DC motor	
Week 10		
Class 28	DC motor	
Class 29	Induction Motor	
Class 30	Alternator	
Week 11		
Class 31	Introduction to electrical wiring	
Class 32	Rules and Regulations for electrical wiring	Class Test, Final
Class 33	Electrical wiring for residential buildings	
Week 12		
Class 34	Electrical wiring for residential buildings	
Class 35	Electrical wiring for industrial buildings	
Class 36	Electrical wiring for industrial buildings	
Week 13		
Class 37	Electrical wiring for commercial buildings	
Class 38	Electrical wiring for commercial buildings	
Class 39	Cost estimation for electrical wiring of a building	
Week 14		
Class 40	Cost estimation for electrical wiring of a building	
Class 41	Introduction to illumination, Illumination for different types of building	
Class 42	Revision	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment Class Test, Assignment, Class participation, Class Attendance, Mid Term Examination	40%	CO1, CO2, CO3, CO4	C2, C2, C3, C4
Final Exam	60%	CO1, CO2, CO3, CO4	C2, C2, C3, C4
Total Marks	100%		

REFERENCE BOOKS

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Alternating Current Circuits – Russell & George F. Corcoran; John Wiley and Sons.
3. A Textbook of Electrical Technology- B.L. Theraja and A.K. Theraja
4. Electrical Wiring, Estimating and Costing - S.L. Uppal; Khanna Publishers
5. Fundamentals of Electric Circuits – Charles Alexander and Mathew Sadiku

Basic Mechanical Engineering and Workshop Sessional offered by ME Department

Fall semester: L-I T-1

COURSE INFORMATION			
Course Code	: ME 132	Lecture Contact Hours	: 3.00
Course Title	: Workshop Technology Sessional	Credit Hours	: 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To help the students to explore various welding techniques and put theory in practice. Our mission is to expose students to the constructions of different mechanical machines and analyze their performance. This course is targeted to verify the working principle of types of welding, casting, mouldings and also to gain knowledge of different manufacturing parts from lathe, drilling, milling and drilling machine etc. and relate them with their theoretical knowledge.

OBJECTIVES

- To use different manufacturing (machining, welding, foundry, sheet metal working, etc.) processes required to manufacture a product from the raw materials.
- To use different measuring, marking, cutting tools used in workshop.
- Be aware of the safety precautions while working in workshop.

COURSE CONTENT

Carpentry shop (3/2 hrs/week)

Wood working tools; wood working machine: band saw, scroll saw, circular saw, jointer, thickness planner, disc sander, wood lathe; types of sawing; common cuts in wood works; types of joint; defects of timber: natural defects and artificial defects; seasoning; preservation; substitute of timber; commercial forms of timber; characteristics of good timber; use of fastening; shop practice: practical job, planning and estimating of a given job.

Machine shop (3/4 hrs/week)

Kinds of tools; common bench and hand tools; marking and layout tools, measuring tools, cutting tools, machine tools, bench work with job; drilling, shaper, lathe and milling machines: introduction, type, size and capacity, uses and applications.

Welding shop (3/4 hrs/week)

Methods of metal joints: Riveting, grooving soldering, welding; Types of welding joints and welding practice; Position of arc welding and polarity: Flat, vertical, horizontal, overhead; Electric Arc welding and its machineries; Welding of different types of materials: Low carbon steel, cast iron, brass, copper, stainless steel, aluminum; Types of electrode, fluxes and their composition; Arc welding defects; Test of Arc welding: Visual, destructive and non-destructive tests. Types of gas welding system and gas welding equipment; Gases and types of flame; welding of different types of materials; Gas welding defects; test of gas welding.

COURSE OUTCOMES AND SKILL MAPPING													
No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Be able to **identify** the basics of tools and equipment used in machining, welding, casting and molding.	√											
2	Be able to **compare** between different types of welding and machining processes and select proper cutting tool for specific machining processes.		√										
3	**Find** out about the importance of general safety precautions on different shop floors.	√											
4	**Develop** practical skills using tools and equipment.					√							

COURSE OUTCOMES AND GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	CP(WP)	CA(EA)	KP(WK)	Assessment Methods
CO1	Be able to **identify** the basics of tools and equipment used in machining, welding, casting and molding.	PO1	C1	-	1	-	Report, Quiz, Lab Test
CO2	Be able to **compare** between different types of welding and machining processes and select proper	PO2, PO3	C1, C3	-	1	-	Report, Quiz, Lab Test

	cutting tool for specific machining processes.						
CO3	**Find** out about the importance of general safety precautions on different shop floors.	PO1	C2	-	-	-	Report, Quiz, Lab Test
CO4	**Develop** practical skills using tools and equipment.	PO5	C3	-	1	-	Report, Quiz, Lab Test

WP= Washington Accord Complex Problem Solving/ CP= Complex Problem Solving; EA= Engineering Activities/ CA= Complex Activities; WK= Washington Accord Knowledge Profile/ KP= Knowledge Profile

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning	
Lecture	14
Practical / Tutorial / Studio	28
Guided Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Independent Learning	
Individual learning	-
Preparation for Report	-
Assessment	
Continuous assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion.

TEACHING SCHEDULE

Weeks	Topics	Remarks
1	Design and making of pattern for casting	Report, Lab Test, Quiz
2	Mold making, casting and assembly of final project	
3	Study of electric arc welding	
4	Study of Resistance Welding/Spot Welding	
5	Study of Welding joints and welding positions	
6	Study of Gas Welding/cutting	
7	Study of TIG and MIG Welding	
8	Manufacturing of machine component by using Lathe machine	
9	Manufacturing of machine component by using Shaper machine	
10	Manufacturing of a machine component by using Milling Machine	
11	Manufacturing of a machine component by using Drilling Machine	
12	Carpentry: Middle Lap T Joint, Cross Lap Joint, Mortise and Tenon T joint, Bridle T Joint	
13	Viva	
14	Quiz Test	

ASSESSMENT STRATEGY

Components	Grading	CO	Blooms Taxonomy
Continuous Assessment Lab Participation and Report	60%	CO1, CO2, CO3, CO4	C1, C3, C4
Lab Quiz	40%	CO1, CO2, CO3, CO4	C2, C3, C4
Total Marks	100%		

REFERENCE BOOKS

1. Machine Shop Practice – James Anderson, W. A. Chapman.
2. Callister W. D., Material Science & Engineering, John Wiley & Sons.

Computer Programing Sessional offered by CSE Department

Spring Semester L-2, T-I

COURSE INFORMATION

Course Code Course Title	: CSE 176 : Computer Programming Sessional	Lecture contact hours Credit hours	: 3.00 : 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This is a hand on training course for computer programming for civil engineers. In this course students will be given basic knowledge on algorithm, problem solving technique and how to apply this in a computer language program.

OBJECTIVE

- To introduce students the basic concepts of C++ language and enable them to write simple correct programs

COURSE CONTENT

Programming concepts and algorithms; internal representation of data; elements of structured programming language: data types, operators, expressions, control structures, functions, pointers and arrays, input and output.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** algorithmic thinking, problem-solving techniques to write clear, simple codes	√											
2	**Use** built-in data types and different operators e.g. arithmetic, increment, decrement, assignment, relational, equality etc effectively	√											
3	**Write** codes using control structures i.e., if, if/else, for, while, do/while etc for solving engineering problems					√							

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** algorithmic thinking, problem-solving techniques to write clear, simple codes	1	C2	1		1,3	Class Assessment/ Quiz
CO2	**Use** built-in data types and different operators e.g. arithmetic, increment, decrement, assignment, relational, equality etc effectively	1	C2	2,3		3	Class Assessment/ Quiz
CO3	**Write** codes using control structures i.e., if, if/else, for, while, do/while etc for solving engineering problems	5	C3	2,3		3	Class Assessment/ Quiz

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)

Face to Face Learning Lecture (2 hours/week x 12 weeks) Class assessment (1 hours/week X09 weeks)	 24 09
Guided Learning Assessnment Preparation (1.0 hours/week x 09 weeks)	09
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for quiz	11 04
Assessment Quiz & Viva	03
Total	60

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Introduction of the course, Concept of Programming (what is C++, Compiling, Debugging, Running a small program etc)	Class Assessment
2	2	Data type, Variables and Constants	
3	3	Operators, System header files	
4	4	Loops (if, elseif) Decision making	
5	5	Loops (for) Decision making	
6		Mid Quiz	Quiz
7	6	Function	Class Assessment
8	7	Loops (while)	
9	8	Vector/array	
10	9	Multi-dimensional Arrays	
11	10	Data file handling	
12	11	String function and Practice Examples	
13	12	Pointer	

14		Final Quiz	Quiz

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Class Assessment	50%	CO1, CO2, CO3	C2, C3
Quiz & viva	50%	CO1, CO2, CO3	C2, C3
Total Marks	100%		

REFERENCE BOOKS

1. Teach Yourself C by Herbert Schildt
2. Programming with C by Schaum's Outline Series
3. Engineering Data Analysis with MATLAB® 1st Edition by Tanvir Mustafy, Md. Tauhid Ur Rahman

Engineering Computation Sessional offered by CSE Department

Fall Semester L-2, T-II

COURSE INFORMATION			
Course Code Course Title	: CSE 274 : Engineering Computations Sessional	Lecture contact hours Credit hours	: 3.00 : 1.50

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
This is a hand on training course for computer programming for civil engineers. In this course, students will be given knowledge to solve real life engineering problems using various numerical methods which will be useful later on in various projects.

OBJECTIVE
• To gain knowledge on the basics of computational programming tools. • To become skilled at the application of various numerical analysis.

COURSE CONTENT
Introduction to hi-level computational programming tools, application to numerical analysis: basic matrix computation, solving systems of linear equations, non-linear equations, differential equations, interpolation and curve fitting, numerical differentiation, numerical integration, application to engineering problems: solving problems related to mechanics, numerical solution of equation of motion etc.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **interpret** high level computational programming tools					√							
2	Ability to **solve** systems of linear equations, Ordinary & Partial Differential equations		√										
3	Ability to **interpret** high level		√										

	computational programming tools												

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **interpret** high level computational programming tools	5	C3	1, 2		1, 2	Class Assessment /Quiz
CO2	Ability to **solve** systems of linear equations, Ordinary & Partial Differential equations	2	C4	2		1, 2	Class Assessment /Quiz
CO3	Ability to **apply** numerical analysis to engineering problems	2	C3	3		2, 3	Class Assessment /Quiz

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (1.5 hours/week x 14 weeks) Class assignment (1 hours/week X14 weeks)	 21 14
Guided Learning Assignment Preparation (1.0 hours/week x 14 weeks)	14
Independent Learning Preparation for tests and examinations	06
Assessment Quiz	05
Total	60

TEACHING METHODOLOGY
Lecture and Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE		
Week	**Topics**	**Assessments**
1	MATLAB Fundamentals	Class Assessment
2	MATLAB Fundamentals	
3	MATLAB Fundamentals	
4	Curve Fittings	
5	Numerical Differentiations & Integrations	
6	Numerical Differentiations & Integrations	
7	Mid-term Quiz	Quiz
8	System of Linear Equations	Class Assessment
9	Roots of the Equations	
10	Eigen Values	
11	Fourier Analyses	
12	Ordinary & Partial Differential Equations	
13	Ordinary & Partial Differential Equations	
14	Final Quiz	Quiz

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**

Assignment Report & Class Assessment	50%	CO1, CO2, CO3	C3, C4
Quiz	50%	CO 1	C3
		CO 2	C4
		CO 3	C3
Total Marks	100%		

REFERENCE BOOKS

1. Numerical Methods for Engineers and Scientists – J. D. Hoffman
2. App. Numerical Methods with Matlab for Engrs and Scientists – S.C. Chapra.
3. Numerical Mathematical Analysis – James b. Scarborough
4. Introductory Methods of Numerical Analysis – S.S. Sastry
5. Numerical Methods for Scientific and Eng. Computation - Jain, Iyengar, Jain.
6. Engineering Data Analysis with MATLAB® 1st Edition - Tanvir Mustafy, Md. Tauhid Ur Rahman
7. Statistics and Data Analysis for Engineers and Scientists - Tanvir Mustafy, Md. Tauhid Ur Rahman

CHAPTER 6

DETAILED SYLLABUS OF BASIC ENGINEERING COURSES

Spring Semester L-1, T-I

COURSE INFORMATION			
Course Code Course Title	: CE 100 : Civil Engineering Drawing	Lecture contact hours Credit hours	: 1.5 : 1.5
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
It is a drawing course where students can lean drawing different linear and curved geometric figures e.g. pentagon, hexagon, octagon, ellipse, parabola, hyperbola; solid geometry. Concept of isometric objects and orthographic views are discussed for clear understanding of students. In this course students will be able to learn how to draw the plan, elevation and sectional view of one storied building and bridges.			
OBJECTIVE			
• To get familiar with different drawing instruments and technical standards. • To develop a deep understanding of different geometric figures • To gain knowledge about drawing isometric and orthographic views. • To understand the concept of plan, elevation and sectional views of one storied building and bridge.			
COURSE CONTENT			
Introduction to civil engineering drawing; Drawing instrument and their uses; lines and dimension; plane geometry: drawing of linear and curved geometric figures, e.g. pentagon, hexagon, octagon, ellipse, parabola, hyperbola; solid geometry: concept of isometric view and oblique view, theory of projections; drawing of isometric view of 3D objects; drawing of orthographic view from isometric view and vice versa, elevations and sectional views of one-storied buildings, culvert, bridges etc.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Recognize** different drawing equipment and technical standards.	√											

2	**Understand** isometric and orthographic views of simple objects.	√											
3	**Draw** plan, elevation and sectional views of residential building	√											

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	**Recognize** different drawing equipment and technical standards.	1	C1	4		3	Class Assessment
CO2	**Understand** isometric and orthographic views of simple objects.	1	C2	2		4	Quiz
CO3	**Draw** plan, elevation and sectional views of residential building	1	C2	1		5	Group Project and Quiz

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

<u>Complex Engineering Activities (A)</u>:

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

<u>Bloom's Taxonomy Levels</u>:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (1 hours/week x 10 weeks)	10
Guided Learning Home Assessment (2 hour/week x 12 weeks)	24
Independent Learning Preparation for tests and examination	05
Assessment Quiz Viva Class Performance(1.5 hr/week X 12 weeks)	 02 01 18
Total	60

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Weeks	**Lectures**	**Topic**	**Assignments**
1.	1	Introduction	Conducted in every class on the relevant topic
	2	Use of Instruments	
	3	Lines and Dimensioning	
	4	Concepts of Isometric view, orthographic and 3D objects	
	5	Plane Geometry: Pentagon, Hexagon, Octagon etc.	
	6	Acquaintance with sheet layout and title block for each day submission	
2.	7	Plane Geometry: Pentagon, Hexagon, Octagon etc.	
	8	Practice on Isometric Views from 3D view	
3.	9	Practice on Isometric Views & Orthographic views of 3D Object	
4.	10	Sectional views of 3D Object	
5.	11	Visualization of 3D view from Isometric view	
6.			**MID TERM QUIZ**

7.	12	Introduction to different components of building	
	13	Understanding symbols on architectural drawings	
8.	14	Plan view of one storied Residential building	
9.	15	Elevation of view of one storied Residential building	
10.	16	Sectional view of one storied Residential Building	
11.	17	Understanding the information provided by the Structural and Architectural drawings	
12.	18		Quiz on Lecture 17
13.	19	Plan, Elevation and Sectional view of Culvert	
14.			**FINAL QUIZ**

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Quiz	70%	CO2, CO3	C1,C2
Assessment	15%	CO 1	C1
		CO 2	C2
		CO 3	C2
Viva and observation	15%	CO2, CO3	C1,C2
Total Marks	100%		

REFERENCE BOOKS

1. Civil Engineering Drawing by - Gurcharan Singh & Subash Chandra

Spring Semester L-1, T-I

COURSE INFORMATION

Course Code	: CE 101	Lecture contact hours	: 3.00
Course Title	: **Analytic Mechanics**	Credit hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Purpose of this course is to provide students the basic concept and in-depth knowledge in the field of mechanics of rigid body which will be helpful for their future study/ courses.

OBJECTIVE

- Understanding different force systems and their basic mathematics in order to solve statically determinate stationary rigid bodies, external / internal forces in a statically determinate beam, trusses and frames composed of pin connected members and forces developed in the cables and supports.
- To apprehend the problems involving friction and their real application (in a limited scale)
- To determine geometric properties like centroids of line, area and volume, theorems of Pappus and Guldinus, centre of pressure along with internal properties of object such as rectangular and polar moment of inertia and radius of gyration of single and composite areas, moment of inertia about inclined axis, maximum and minimum moment of inertia, moment of inertia of masses.
- Solve different problems with the concept of principle of Impulse and Momentum.

COURSE CONTENT (2021)

Coplanar and non-coplanar force systems; concepts of free body diagram, equations for static equilibrium; internal forces and moments, analyses of two-dimensional frames and trusses; friction, impending moment; introduction to space frames; centroids of lines, areas and volumes; moments of inertia of areas and masses; linear and angular impulse and momentum.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **understand** free body diagram of different types of rigid bodies.	√											

2	Ability to **apply** equations of equilibrium to analyze statically determinate rigid bodies.		√										
3	Ability to **estimate** the geometric properties like centroids, moment of inertia etc. of different objects.	√											
4	Ability to **apply** the principles of impulse and momentum.		√										

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **understand** free body diagram of different types of rigid bodies.	1	C2	1		3	Class Test/ Assignment
CO2	Ability to **apply** equations of equilibrium to analyze statically determinate rigid bodies.	2	C3	1		3, 4	Class Test/ Assignment/ Mid-term/ Pop quiz/ Final Exam
CO3	Ability to **estimate** the geometric properties like centroids, moment of inertia	1	C3	1		3, 4	Class Test/ Assignment/ Mid-term/ Pop quiz/ Final Exam

	etc. of different objects.						
CO4	Ability to **apply** the principles of impulse and momentum	2	C3	1		3	Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (4 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments (4 hours/week x 5 weeks)	18
Independent Learning Individual learning (1 hour lecture ≈1.0 hour learning) Preparation for tests and examination	33 22
Assessment Pop Quiz/Class Test/Mid-Term Exam Final examination	2 3
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE			
Week	**Lectures**	**Topics**	**Assessments**
1	1	Resultant and Components of Forces	Assignment, Class Test, Mid-term, Pop quiz, Final Exam
	2	Types of Forces and Introduction to Coplanar Concurrent Forces	
	3	Centroids: Definitions of centroids, centre of mass and centre of gravity, Formulas of centroids for line, area and volume.	
2	4	Concept of Equilibrium	
	5	Free Body Diagrams	
	6	Principle of symmetry and centroid, centroid by summation method	
3	7	Introduction to Truss	
	8	Analysis of Truss by joint Method	
	9	Centroid by Integration, practice centroid of lines by integration, Centroid of plane triangle, Centroid of sector of a circle, Centroid of area without axis of symmetry.	
4	10	Analysis of Truss by Joint to Joint Method	
	11	Tutorial 1(on Forces, Resultant and Components)	
	12	Centroid of a volume (right circle cone, cylinder, hemisphere etc.).	
5	13	Tutorial on Analysis of Truss/Frames	
	14	Concept of Moments	
	15	Centroid of composite area, Centroid of composite volume	
6	16	Concept of Parallel Force System	
	17	Determination of Reaction Forces, Forces on Members of Frames	
	18	Centroid of composite area, Centroid of composite volume	
7	19	Tutorial on Determination of Reaction Forces, Forces on Members of Frames	
	20	Tutorial on Determination of Reaction Forces, Forces on Members of Frames	
	21	Theorem of Pappus and Guldinus, Center of Pressure	
8	22	Non-Concurrent, Non – Parallel, Coplanar Forces	

	23	Concept of Rectangular and Polar moment of Area and radius of gyration, Parallel axis and perpendicular axis theorem (Transfer formula, rectangular to polar)	
	24	Practice problems of Rectangular Moment of Inertia and radius of gyration with axis of symmetry (Rectangle, triangle etc.)	
9	25	Moment of inertia of areas by integration	
	26	Tutorial on Analysis of Truss by Method of Section	
	27	Moment of inertia of composite areas	
10	28	Tutorial on Non-Concurrent, Non – Parallel, Coplanar Forces	
	29	Moment of Inertia about Inclined Axis, Product of Inertia	
	30	Maximum and Minimum Moment of Inertia by formula and Mohr's circle	
11	31	Moment of inertia of masses	
	32	Concept of Friction and problems associated with Friction	
	33	Moment of inertia of mass and practice problems (solid cylinder, Sphere, thin disk, cone)	
12	34	Analysis of Wedges	
	35	Moment of Inertia of masses of composite bodies	
	36	Planar kinematics of rigid bodies: Impulse and momentum	
13	37	Tutorial on Friction and Belt Friction	
	38	Principle of impulse and momentum	
	39	Problems solving on linear impulse and momentum	
14	40	Problem solving on Wedges	
	41	Problems solving on angular impulse and momentum	
	42	Problems solving on linear and angular impulse - momentum	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3, CO4	C2, C3

Final Exam	60%	CO2, CO3, CO4	C3
Total Marks	100%		
REFERENCE BOOKS			
1. “Analytic Mechanics” by – Faires & Chambers (3rd Edition) 2. “Engineering Mechanics” by – Singer 3. “Engineering Mechanics: Statics”, 13th Ed., Hibbeler 4. “Engineering Mechanics: Dynamics”, 13th Ed., Hibbeler			

Fall Semester L-1, T-II

COURSE INFORMATION			
Course Code Course Title	: CE 102 : Computer Aided Drawing	Lecture contact hours Credit hours	: 3.00 : 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course will be useful for drawing of basic civil engineering components using AutoCAD software which will be helpful during project work in later semesters as well as in engineering practice.

OBJECTIVE

- To know about basics engineering drawing formats
- To gain knowledge about the basic functions of AutoCAD efficiently
- To take data and transform it into graphic drawings

COURSE CONTENT

Introduction to Computer Aided Drawing (CAD), Introduction to CAD packages, Basic drawing and modifying tools of AutoCAD, Drawing, editing and dimensioning of any objects, Isometric view and orthographic view of 3D object; Plan, elevation and sectional views of multi-storied buildings, Reinforcement details of beams, slabs, stairs etc.; Plan and section of septic tank; plans, elevations and sections of culverts, bridges and other hydraulic structures; drawings of building services.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **understand** the basic concept of AutoCAD software in civil engineering applications					√							
2	Ability to **apply** the knowledge to draw detail architectural and structural drawing of a residential building	√											
3	Ability to **apply** the knowledge to draw sectional view, plan	√											

	view and elevation of various structures												

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **understand** the basic concept of AutoCAD software in civil engineering applications	5	C1			1	Class Assessment/ Quiz
CO2	Ability to **apply** the knowledge to draw detail architectural and structural drawing of a residential building	1	C2			4	Class Assessment/ Quiz
CO3	Ability to **apply** the knowledge to draw sectional view, plan view and elevation of various structures	1	C2			4	Class Assessment/ Quiz

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (1.5 hours/week x 12 weeks) Class assessment (1 hours/week X10 weeks)	 18 10
Guided Learning Assignment Preparation (1.0 hours/week x 09 weeks)	09
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for quiz	12 06
Assessment Quiz & Viva	05
Total	60
TEACHING METHODOLOGY	
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)	

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Introduction to computer usage Introduction to CAD packages and computer aided drawing	Class Assessment
2	2	Drawing editing and dimensioning of simple objects	
3	3		
4	4		
5	5	Plan, elevations and sections of multi-storied buildings	
6	6		
7		Mid Term Quiz	Quiz
8	7	Reinforcement details of beams, slabs, stairs etc.	Class Assessment
9	8	Plan and section of septic tank	
10	9	Detailed drawings of roof trusses	
11	10	Plans, elevations and sections of culverts, bridges and other hydraulic structures	
12	11	Drawings of building services	
13		Viva	Viva

14		Final Quiz	Quiz

ASSESSMENT STRATEGY

Components	Grading	CO	Blooms Taxonomy
Class Assessment & Assignment	50%	CO1, CO2, CO3	C1, C2
Quiz & viva	50%	CO1, CO2, CO3	C1, C2
Total Marks	100%		

REFERENCE BOOKS

1. Civil Engineering Drawing by - Gurcharan Singh & Subash Chandra

Fall Semester L-1, T-II

<table>
<tr><th colspan="4">COURSE INFORMATION</th></tr>
<tr><td>Course Code
Course Title</td><td>: CE 103
: Surveying and Spatial Information Engineering</td><td>Lecture contact hours
Credit hours</td><td>: 3.00
: 3.00</td></tr>
<tr><th colspan="4">PRE-REQUISITE</th></tr>
<tr><td colspan="4">None</td></tr>
<tr><th colspan="4">CURRICULUM STRUCTURE</th></tr>
<tr><td colspan="4">Outcome Based Education (OBE)</td></tr>
<tr><th colspan="4">SYNOPSIS/RATIONALE</th></tr>
<tr><td colspan="4">The purpose of this course is to introduce various surveying techniques for conducting land and hydrographic survey which will be useful in various projects in the later semesters and in their professional life.</td></tr>
<tr><th colspan="4">OBJECTIVE</th></tr>
<tr><td colspan="4">• To understand the measurement techniques used in land and hydrographic surveying.
• To develop a deep understanding on techniques, skills and modern tools necessary for surveying.
• To gain knowledge on remote sensing, spatial measurement and spatial information management.
• To gain knowledge on highway/railway curve setting techniques.
• To understand the background concept of contour map production.</td></tr>
<tr><th colspan="4">COURSE CONTENT</th></tr>
<tr><td colspan="4">Introduction to Surveying, History of Surveying, Surveying Instruments and their uses, Sources of errors, Linear measurements, Chain surveying, Project survey, Route survey, Leveling, Calculation of area and volumes, Traverse survey, Contouring, Curve and curve ranging: transition curves, super-elevation and vertical curves, Trigonometric levelling, Principles and problems of tachometry. Introduction to remote sensing, use and application of remote sensing, Introduction to photogrammetric survey, Acoustic measurements and investigations, hydrographic operations.</td></tr>
<tr><th colspan="4">COURSE OUTCOMES AND SKILL MAPPING</th></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">COURSE OUTCOMES (COs)</th><th colspan="12">PROGRAMME OUTCOMES (POs)</th></tr>
<tr><th>PO1</th><th>PO2</th><th>PO3</th><th>PO4</th><th>PO5</th><th>PO6</th><th>PO7</th><th>PO8</th><th>PO9</th><th>PO10</th><th>PO11</th><th>PO12</th></tr>
<tr><td>1</td><td>Ability to understand the working principles of various survey methods, equipment and tools for conducting land, Project and hydrographic survey and spatial information analysis</td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

2	Ability to **explain** the principles of various methods for curve settings and earth works calculation for highway/railway projects		√										
3	Ability to **use** different survey methods in solving engineering problems		√										

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **understand** the working principles of various survey methods, equipment and tools for conducting land, Project and hydrographic survey and spatial information analysis	1	C1			3	Class Test, Mid-term, Pop quiz, Final Exam
CO2	Ability to **explain** the principles of various methods for curve settings and earth works calculation for highway/railway projects	2	C2, C3			4,5	Class Test, Mid-term, Pop quiz, Final Exam
CO3	Ability to **use** different survey methods in solving engineering problems	2	C2, C3			4	Class Test, Mid-term, Pop quiz, Final Exam

<u>Knowledge Profile (K)</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

<u>Complex Engineering Problem (P)</u>:

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence **Complex Engineering Activities (A)**: **A1**: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity **Bloom's Taxonomy Levels**: **C1**: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create	
TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	15
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	36 22
Assessment Continuous Assessment Final examination	2 3
Total	120
TEACHING METHODOLOGY	
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)	

TEACHING SCHEDULE			
Week	**Lectures**	**Topics**	**Assessments**
1	1	Introduction to surveying	CT, Final exam
	2	History of Surveying, Surveying Instruments and their uses	
	3	Tacheometry : introduction and applicability , equipment for tacheometry	
2	4	Introduction to remote sensing	
	5	Principle of stadia method, calibration of a tacheometer	
	6	Formulations for distance and elevation by tacheometry	
3	7	Introduction to remote sensing	
	8	Project survey	
	9	Use and application of remote sensing	
4	10	Route survey	CT, Final Exam
	11	Linear measurements	
	12	Introduction to photogrammetric survey	
5	13	Introduction to photogrammetric survey	
	14	Introduction to photogrammetric survey	
	15	Trigonometric Levelling	
6	16	Traverse survey	CT 2 Final exam
	17	Traverse survey	
	18	Traverse survey	
7	19	Levelling	
	20	Levelling	
	21	Levelling	
8	22	Levelling	
	23	Contouring	
	24	Contouring	
9	25	Different methods of curve setting for simple circular curve	

	26	Different types of curves, basic definitions of simple circular curve	CT 3
	27	Curves and curve setting	
10	28	Curves and curve setting	
	29	Solving problems on curve setting	Final exam
	30	Transition curve: characteristics, superelevation, equilibrium cant and cant deficiency	
11	31	Length of transition curve, formulation of transition curve	
	32	Calculation of area	
	33	Calculation of area	
12	34	Calculation of area	Mid Final exam
	35	Solving problems on transition curve	
	36	Solving problems on transition curve	
13	37	Cubic parabola as vertical curves, basic definitions, different types of vertical curves	
	38	Solving problems on vertical curves	
	39	Acoustic measurements and investigations	
14	40	Acoustic measurements and investigations	
	41	Calculation of volume	
	42	Calculation of volume	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C1, C2, C3
Final Exam	60%	CO 1	C1
		CO 2	C2, C3
		CO 3	C2, C3
Total Marks	100%		

REFERENCE BOOKS
1. Surveying - Volume I, II, III by B.C. Punmia (SI Units) 2. A Textbook of Surveying by M.A. Aziz & Shahjahan 3. Surveying and Levelling by N N Basak

Fall Semester L-1, T-II

COURSE INFORMATION			
Course Code Course Title	: CE 104 : Practical Surveying	Lecture contact hours Credit hours	: 3 weeks : 1.50

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
The purpose of this course is to introduce various instruments of surveying and applying those in the field. This training will be useful for the students in professional field.

OBJECTIVE
• To orient the students with the use of various instruments of surveying and applying those in the field of survey • To utilize the students' theoretical knowledge on surveying (CE-103) into practical fields • To train the students to plan and execute survey work for any engineering project

COURSE CONTENT
Linear and angular measurement techniques; traverse surveying; leveling and contouring; curve setting; Trigonometric Survey; route survey; tacheometry; project surveying; modern surveying equipment and their applications.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Employ** appropriate survey techniques for civil engineering works	√											
2	**Analyze** survey data to meet the objectives of field work		√										
3	**Work** effectively as an individual and also as a member of a team in survey field works									√			

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society,

PO7: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning							
COURSE OUTCOMES AND GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Employ** appropriate survey techniques for civil engineering works	1	3			3	Daily Quiz/ Report/Final quiz/Viva
CO2	**Analyze** survey data to meet the objectives of field work	2	4			4	Daily Quiz/ Report/Final quiz/Viva
CO3	**Work** effectively as an individual and also as a member of a team in survey field works	9	3			4	Daily Quiz/ Report/Final quiz/Viva

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning	
Lecture (5 hours/week x 3 weeks)	15
Field Work (25 hours/week x 3 weeks)	75
Guided Learning	
Report preparation	10
Independent Learning	
Preparation for quiz & viva	5

Assessment Quiz & viva	5
Total	110

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Linear and angular measurement techniques	Daily Quiz/ Report
	2	Route survey; Calculation of cut and fill volume	
	3	Traverse surveying	
	4	Trigonometric surveying	
	5	Tacheometry surveying	
2	6	Contouring	
	7	Curve Setting: Simple Circular Curve	
	8	Curve Setting: Combined Curve	
	9	House Setting	
	10	Hydrographic survey	
3	11	Application of modern surveying equipment's like GPS, Total station, RTK GPS etc.	
	12		
	13		
	14		
	15		
4	16	Field Test	Field Test
	17	Viva &Final Quiz	Viva & Final Quiz

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Daily Quiz & Report	50%	CO1, CO2, CO3	3,4
Field Test ,Viva & Peer Evaluation	50%	CO1, CO2, CO3	3,4
Total Marks	100%		

REFERENCE BOOKS
1. Surveying - Volume I, II, III by B.C. Punmia (SI Units) 2. A Textbook of Surveying by M.A. Aziz & Shahjahan 3. Surveying and Levelling by N N Basak

Spring Semester L-2, T-I

COURSE INFORMATION

Course Code Course Title	: CE 200 : Details of Constructions	Lecture contact hours Credit hours	: 3.00 : 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

In this course, students will be introduced to components of different civil engineering structures and construction practices. This hands-on training will be useful for the students in later studies and construction projects.

OBJECTIVE

- To impart knowledge on the basics of different types of components of a building, design loads, framed structure and load-bearing wall structure.
- To equip students with knowledge of various construction materials and their application in structures.
- To make the students efficient in the practical field understanding through site visits and technical sessions.

COURSE CONTENT

Types of building, components of a building, design loads, framed structure and load bearing wall structure; **foundations**: shallow and deep foundation, site exploration, bearing capacity of the soil, standard penetration test; **brick masonry**: types of brick, bonds in brickwork, supervision of brickwork, defects and strength on brick masonry, typical structures in brickwork, load bearing and non-load bearing walls, cavity walls, partition walls; **lintels and arches**: different types of lintels and arches, loading on lintels, construction of arches; **stairs:** different types of stairs, **floors:** ground floors and upper floors; roofs and roof coverings; **shoring; underpinning; scaffolding and formwork**; **plastering**, pointing, painting; distempering and whitewashing; **concrete:** cement, concrete construction, admixture; **sound insulation**: acoustics; **thermal insulation**; **house plumbing**: water supply and wastewater drainage; **thunder arrestor. Project site visit.**

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the components of substructure and superstructure of a building, properties of construction materials, design	√											

	loads, framed structure and load-bearing wall structure												
2	**Understand** the finishing and formwork of a building, heat and thermal insulation, and water supply and wastewater drainage system	√											
3	**Recognize** different aspects of construction materials and work through field visits and teamwork									√			

<u>**Program Outcomes (PO)**</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the components of substructure and superstructure of a building, properties of construction materials, design loads, framed structure and load-bearing wall structure	1	C1	-		1	Class Assessment/Report/ Quiz/Viva
CO2	**Understand** the finishing and formwork of a building, heat and thermal insulation, and water supply and wastewater drainage system	1	C1	-		1	Class Assessment/ Report/Quiz/Viva

CO3	**Recognize** different aspects of construction materials and work through field visits and teamwork	9	C2	-		1,6	Report/Poster Presentation

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning	
Lecture (2 hours/week x 9 weeks)	18
Class assessment (1 hours/week X9 weeks)	9
Site visit (3 hours/week X2 weeks)	6
Guided Learning	
Assessment and Report Preparation (1.0 hours/week x 9 weeks)	9
Independent Learning	
Individual learning (1-hour lecture ≈ 1-hour learning)	9
Preparation for quiz	4
Assessment	
Quiz & Viva	3
Poster Presentation	1
Presentation	1
Total	60

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE			
Week	**Lectures**	**Topics**	**Assessments**
1	1	Introduction to Building	Class Assessment/Report/Quiz/ Viva
2	2	Floors, Roofs and Stairs	
3	3	Brick Masonry	
4	4	Plastering, Painting, Pointing; Lintels and Arches	
5	5	Cement, concrete construction and admixture	
6		Site Visit	Presentation
7	6	Shoring; Underpinning; Scaffolding and Formwork	Class Assessment/Report/Quiz/ Viva
8		Mid Quiz	Quiz
9	7	Introduction to Foundations and Soil Investigation	Class Assessment/Report/Quiz/ Viva
10	8	House plumbing, water supply and wastewater drainage	
11	9	Sound insulation, Thermal insulation, Thermal arrestor	
12		Site visit	Presentation
13		Final Quiz	Quiz
14		Presentation &Viva	Presentation

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Class Assessment/Report	30%	CO1, CO2	C1
Quiz & Viva	50%	CO1, CO2	C1
Presentation	20%	CO3	C2
Total Marks	100%		

REFERENCE BOOKS

1. Building Construction by – Sushil Kumar
2. Building Construction by – Dr. B.C. Punmia
3. Building Construction Engineering by Gurcharan Singh
4. Concrete and Formwork by by T W Love
5. Building Construction by – W.B. McKay (Vol. 1)
6. BDA Guide to Successful Brickwork" by the Brick Development Association.
7. Concrete Construction, by Ken Nolan
8. Formwork for Concrete by M.K. Hurd, Fifth Edition,

9. New Scaffolding Guidance TG20:08 – Guide to Good Practice for Scaffolding with Tube and Fittings NASC (National Access and Scaffolding Confederation), UK
10. Plumbing a House: For Pros by Pros by Peter Hemp
11. Construction Drawings and Details for Interiors: Basic Skills, 2nd Edition" by Rosemary Kilmer and W.Otie Kilmer
12. Sound Insulation by Carl Hopkins
13. Popular Mechanics Complete Home How-to by Albert Jackson, David Day
14. PWD manual on house construction and plumbing

Fall Semester L-2, T-II

COURSE INFORMATION

Course Code Course Title	: CE 201 : Engineering Materials	Lecture contact hours Credit hours	: 3.00 : 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

It is a basic course for the students to learn the properties, manufacturing process and uses of construction materials. The course is intended to provide necessary knowledge to the students which will be useful in various projects in the later semesters and in their professional life.

OBJECTIVE

- To gain knowledge on the properties of various aggregates and construction materials.
- To be able to identify the suitability of engineering materials for different types of construction works.
- To develop an understanding on manufacturing process of bricks, cement etc.
- To design concrete mix by appropriate methods.

COURSE CONTENT

Properties and uses of aggregates, brick, cement; sand, lime; concrete; concrete mix design; admixtures; wood structures and properties; shrinkage and seasoning; treatment and durability; mechanical properties; wood products; basic property of FRP composites and available FRP composite products; steel; aluminum; introduction to geo-textiles; definition of stress and strain; plane stress and strain condition; identification of strain components of elastic, elasto-plastic and elasto-visco-plastic materials; time dependent strain response of these materials due to different types of loadings; mathematical and simple rheological modelling for prediction of creep behavior; ferro-cement: advantages and uses; corrosion and prevention of steel in RC structures; offshore structures; application of nano technology in cement and concrete; introduction to high performance material (ie., green building materials, ECC etc).

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Identify** the properties and suitability of engineering materials for different types of	√											

	construction works												
2	**Understand** the production process of engineering materials (Bricks, Cement etc.) and their uses in Bangladesh.		√										
3	**Use** appropriate method to **Undertake** basic design calculations for concrete mix.		√										

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	**Identify** the properties and suitability of engineering materials for different types of construction works	1	C2			3,4	Class Test, Mid-term, Assignment, Final Exam
CO2	**Understand** the production process of engineering materials (Bricks, Cement etc.) and their uses in Bangladesh.	2	C2			4, 5	Class Test, Mid-term, Assignment, Final Exam
CO3	**Use** appropriate method to	2	C3	1,2,3		5,6	Class Test, Mid-term,

	Undertake basic design calculations for concrete mix.						Assignment,Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	15
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	36 22
Assessment Continuous Assessment Final examination	2 3
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Tutorial, Problem Based Learning (PBL)

TEACHING SCHEDULE			
Week	**Lectures**	**Topics**	**Assessments**
1	1	Properties of Aggregates	CT/Mid/ Assignment/ Term Final
	2	Uses of Aggregates	
	3	Properties and Uses of Aggregates	
2	4	Bricks- Quality, Constituents, Characteristics etc.	
	5	Brick- Tests, Types, Classifications, Use etc.	
	6	Brick- Manufacturing Process, Kilns etc.	
3	7	Cement- Properties	
	8	Cement- Different types and characteristics	
	9	Cement- Manufacturing process	
4	10	Sand- Source, Types, FM, Classification	CT/Mid/ Assignment/ Term Final
	11	Sand- Classification, Use, test and bulking	
	12	Lime- Properties, Source, Production, Classification	
5	13	Lime- Hydraulicity, Calcination, Slaking, Use	
	14	Mortars- Types, Components, Functions, Properties, Uses	
	15	Mortars- Methods of mixing, Preparation, Types, Varieties, Curing etc.	
6	16	Concrete- Properties, Ingredients, Related Terminologies, Types	CT/Mid/ Assignment/ Term Final
	17	Concrete – Workability, Segregation , Bleeding, Strength, Porosity, Aggregate properties	
	18	Concrete- Mixing, Handling, Placing, Effect, Chemical reaction	
7	19	Concrete- Strength, Factors, Permeability, Curing, Testing	
	20	Concrete- Advances in concrete technology, Special types of concrete	
	21	Basic property of FRP composites and available FRP composite products	
8	22	Basic property of FRP composites and available FRP composite products	
	23	Steel; Aluminum	

	24	Stress and strain; plane stress and strain condition;	
9	25	Identification of strain components of elastic, elasto-plastic and elasto-visco-plastic materials	
	26	Time dependent strain response of these materials due to different types of loadings; mathematical and simple rheological modeling for prediction of creep behavior	
	27	Ferro-cement: advantages and uses	
10	28	Ferro-cement: advantages and uses	
	29	Corrosion and prevention of steel in RC structures; Offshore structures	
	30	Corrosion and prevention of steel in RC structures; Offshore structures	
11	31	Material for ground improvement	
	32	Application of nano technology in cement and concrete	
	33	Introduction to high performance material (ie., green building materials, ECC etc).	
12	34	Concrete Mix Design- Principles, Material requirement, Workability, Quality Control	CT/Mid/ Assignment/ Term Final
	35	Concrete Mix Design-Design of low and medium strength concrete, Design of high strength concrete	
	36	Concrete Mix Design- Light weight concrete, Mass concrete, High density concrete, Fly Ash Cement concrete,	
13	37	Concrete Mix Design- Design of concrete mixes according to British and American standard.	
	38	Admixtures- Properties, Effectiveness, Functions	
	39	Admixtures- Different types and uses	
14	40	Wood structures and properties; shrinkage and seasoning	
	41	Wood -treatment and durability	
	42	Wood- mechanical properties; wood products	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2,CO3	C2, C3
Final Exam	60%	CO 1	C2
		CO 2	C2
		CO 3	C3
Total Marks	100%		

REFERENCE BOOKS

1. Engineering Materials by - M.A. Aziz
2. Building Materials by Gurcharan Singh
3. A Text book of Engineering Materials by G.J. Kulkarni (6th Edition)
4. Engineering Materials Technology: Structures, Processing, Properties, and Selection (5th Edition) by James A. Jacobs and Thomas Kilduff

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code Course Title	: CE 203 : Engineering Geology and Geomorphology	Lecture contact hours Credit hours	: 3.00 : 3.00

PRE-REQUISITE
None
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
This course provides engineers the background knowledge of geologic characterization and the evaluation of the earth's surface for engineering-issues. It also aims to shed light on landforms, land forming processes, and landscape evolution. However, the intent is to develop a fundamental understanding of geologic-issues from an engineering point of view.
OBJECTIVE
• To have through understanding of rocks as an engineering material. • To have profound knowledge on the fluvial processes and landforms. • To comprehend the technical issues related to geological structures and tectonics.
COURSE CONTENT
Petrology: Igneous rock, metamorphic rock, sedimentary rock. **Mineralogy:** Rock and soil minerals. **Soil**: soil classification and transportation methods. **Structural geology:** Folds, faults, joints, doms and basin. **Earthquake and seismotectonic aspect:** Different types of earthquake waves and effects; **Geomorphic processes**; **Runoff and runoff relations**; **Valleys and valley formation**; **Fluvial processes and landforms**: Erosion, transportation and deposition; river dynamics, channel patterns and the basin; **Geology of Bangladesh:** Geology and geo-morphological aspect.

COURSE OUTCOMES AND SKILL MAPPING													
No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1.	Ability to **understand** the dynamics of landforms, hydrogeology, and mineralogical compositions of soils and rocks.	√											
2.	Ability to **understand** the earthquake	√											

	mechanism and zoning map of Bangladesh												
3	Ability to **comprehend** the general trends in geo-morphological formations and its importance in riverine areas of Bangladesh		√										

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **understand** the dynamics of landforms, hydrogeology, and mineralogical compositions of soils and rocks.	1	C1	-	-	3	Class Test, Mid-term, Final Exam
CO2	Ability to **understand** the earthquake mechanism and zoning map of Bangladesh	1	C1	-	-	3	
CO3	Ability to **comprehend** geomorphological systems and riverine areas of Bangladesh.	2	C2	-	-	3	

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	-
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	42 21 21
Assessment Continuous Assessment Final examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Tutorial, Problem Based Learning (PBL)

TEACHING SCHEDULE

Lecture	**Topic**	**Remarks**
Week-1		
Lecture-1	Introduction to Geomorphology	CT-1, Final
Lecture-2	Introduction to Geology	CT-2, Final
Lecture-3	Introduction to Mineralogy	
Week-2		
Lecture-4	Introduction to Geomorphology	CT-1, Final

Lecture-5	Introduction to Mineralogy	CT-2, Final
Lecture-6		
Week-3		
Lecture-7	Geomorphologic processes	Final
Lecture-8	Introduction to rock and different rock forming process	Mid exam
Lecture-9		
Week-4		
Lecture-10	Geomorphologic processes	Final
Lecture-11	Rock cycle	Mid exam
Lecture-12	Introduction to soil	Final
Week-5		
Lecture-13	Runoff and runoff relations	Final
Lecture-14	Introduction to soil and transportation methods	
Lecture-15		
Week-6		
Lecture-16	Runoff and runoff relations	Final
Lecture-17	Structural geology	
Lecture-18		
Week-7		
Lecture-19	Runoff and runoff relations	
Lecture-20	Structural geology	
Lecture-21		
Week-8		
Lecture-22	River valley formation	CT-3, Final
Lecture-23		
Lecture-24	Earthquake mechanism and related hazards	Final
Week-9		
Lecture-25	River transportation processes	CT-3, Final
Lecture-26		
Lecture-27	Structural geology	Final
Week-10		
Lecture-28	River transportation processes	CT-3, Final

Lecture-29		
Lecture-30	Earthquake mechanism, wave types and related hazards	Final
Week-11		
Lecture-31	Drainage Pattern, Quantitative analysis of stream network	
Lecture-32		
Lecture-33	Earthquake mechanism, wave types and related hazards	
Week-12		
Lecture-34	Fluvial process and landforms	
Lecture-35		
Lecture-36	Geological formation of Bangladesh	
Week-13		
Lecture-37	Fluvial process and landforms	
Lecture-38		
Lecture-39	Geological formation of Bangladesh	
Week-14		
Lecture-40	Review	
Lecture-41		
Lecture-42		

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C1, C2
Final Exam	60%	CO 1, CO2, CO3	C1, C2
Total Marks	100%		

REFERENCE BOOKS

1. Geology for Civil Engineers: A.C. McLean & C.D. Gribble
2. Foundations of Engineering Geology: Tony Waltham
3. Fundamentals of Geomorphology: Richard John Huggett
4. Key Concept in Geomorphology: Paul R. Bierman & David R. Montgomery

Fall Semester L-2, T-II

COURSE INFORMATION			
Course Code Course Title	: CE 205 : Numerical Methods for Engineering	Lecture contact hours Credit hours	: 3.00 : 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

In this course students will be given basic knowledge on various numerical solution techniques and computations. This will be useful for the students in a later stage of their study, as well as professional life.

OBJECTIVE

- To gain knowledge on the basic computations on numerical problems.
- To become skilled in using numerical solution techniques.
- To learn the schemes of reducing the numerical errors in basic computations.

COURSE CONTENT

Fundamental of numerical computing (e.g. numericalmodel, convergence, accuracy and stability) and error estimation; system of liner equations (Cramer's rule,Gaussian Elimination,LU factorization, Error analysis for liner systems, Iterative methods-Jacobi Method, Gauss-Seidel iteration, convergence of Iterative methods; Eigen Value Problems); Solving non-liner equations (root findings-Bi-section method,Newton-Raphson Method, Method of False Position); Interpolations (Polynomial interpolation, Piecewise/cubic spline interpolation Lagrange interpolation, and Chebyshev interpolation); Numerical differentiation and Integration(trapezoid,Romberg, Gauss, adaptive quadrature); Numerical solution of Ordinary Differential Equation (Initial Value Problem: Euler Method, Modified Euler Method, Range-Kutta Method);Numerical solution of Ordinary Differential Equation (Boundary Value Problem: Finite difference method and Shooting method, convergence and stability); Least square approximation (parameter estimation and curve fitting); Optimization Method; Numerical solution of Partial Differential Equations.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **understand** the theoretical workings of various numerical	√	√										

	techniques and to **solve** the engineering problems.												
2	Ability to **analyze** the distinctive characteristics of various numerical techniques and the associated error measures.			√									
3	Ability to **apply** the principles of various numerical techniques to solve distinctive numerical problems.			√									√

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **understand** the theoretical workings of various numerical techniques and to **solve** the engineering problems.	1, 2	C2/C3	1		1, 2	Class Test, Mid-term, Pop quiz, Final Exam
CO2	Ability to **analyze** the distinctive characteristics of various numerical techniques and the associated error measures.	3	C4/C5	2, 4		3	Class Test, Mid-term, Pop quiz, Final Exam
CO3	Ability to **apply** the principles of various numerical techniques to solve distinctive	3, 12	C3	3		3, 4	Class Test, Mid-term, Pop quiz, Final Exam

	numerical problems.						

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	15
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	36 22
Assessment Continuous Assessment Final examination	2 3
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE			
Week	**Lectures**	**Topics**	**Assessments**
1	1	Fundamentals of numerical computing (e.g. Numerical model, convergence, accuracy and stability)	CT/ Assignment-1
	2	Fundamentals of numerical computing (e.g. Numerical model, convergence, accuracy and stability)	
	3	Solving non-linear equations (Root Findings-Method of False position)	
2	4	Interpolations (Polynomial interpolation, Piecewise/cubic spline interpolation Lagrange interpolation, and Chebyshev interpolation)	
	5	Interpolations (Polynomial interpolation, Piecewise/cubic spline interpolation Lagrange interpolation, and Chebyshev interpolation)	
	6	Error estimations and optimization methods	
3	7	Error estimations and optimization methods	
	8	Fundamentals of Statistical Decision Making	
	9	Fundamentals of Statistical Decision Making	
4	10	Fundamentals of Statistical Decision Making	CT/ Assignment-2
	11	Evidence-Based Observational Decision Making	
	12	Evidence-Based Observational Decision Making	
5	13	Evidence-Based Observational Decision Making	
	14	Drawing Inferences from Sample Data	
	15	Drawing Inferences from Sample Data	
6	16	Drawing Inferences from Sample Data	Mid Term/ Assignment-3
	17	Drawing Inferences from Sample Data	
	18	Drawing Inferences from Hypotheses Testing	
7	19	Drawing Inferences from Hypotheses Testing	
	20	Drawing Inferences from Hypotheses Testing	
	21	Drawing Inferences from Hypotheses Testing	
8	22	Numerical differentiation and Integration (Trapezoid, Romberg, Gauss adaptive quadrature)	

	23	Numerical differentiation and Integration (Trapezoid, Romberg, Gauss adaptive quadrature)	
	24	Numerical differentiation and Integration (Trapezoid, Romberg, Gauss adaptive quadrature)	
9	25	Numerical differentiation and Integration (Trapezoid, Romberg, Gauss adaptive quadrature)	
	26	Numerical differentiation and Integration (Trapezoid, Romberg, Gauss adaptive quadrature)	
	27	Numerical differentiation and Integration (Trapezoid, Romberg, Gauss adaptive quadrature)	
10	28	Numerical differentiation and Integration (Trapezoid, Romberg, Gauss adaptive quadrature)	
	29	Numerical solution of Ordinary Differential Equation (Initial Value Problems: Euler Method, Modified Euler Method & Boundary value problem: Finite Difference Method and Shooting Method, Convergence and Stability)	
	30	Numerical solution of Ordinary Differential Equation (Initial Value Problems: Euler Method, Modified Euler Method & Boundary value problem: Finite Difference Method and Shooting Method, Convergence and Stability)	
11	31	Numerical solution of Ordinary Differential Equation (Initial Value Problems: Euler Method, Modified Euler Method & Boundary value problem: Finite Difference Method and Shooting Method, Convergence and Stability)	
	32	Numerical solution of Ordinary Differential Equation (Initial Value Problems: Euler Method, Modified Euler Method & Boundary value problem: Finite Difference Method and Shooting Method, Convergence and Stability)	
	33	Numerical solution of Ordinary Differential Equation (Initial Value Problems: Euler Method, Modified Euler Method & Boundary value problem: Finite Difference Method and Shooting Method, Convergence and Stability)	
12	34	Numerical solution of Ordinary Differential Equation (Initial Value Problems: Euler Method, Modified Euler Method & Boundary value problem: Finite Difference Method and Shooting Method, Convergence and Stability)	CT/ Assignment-4

	35	Numerical solution of Ordinary Differential Equation (Initial Value Problems: Euler Method, Modified Euler Method & Boundary value problem: Finite Difference Method and Shooting Method, Convergence and Stability)	
	36	Numerical Solution of Partial Differentiation Equations	
13	37	Numerical solution of Ordinary Differential Equation (Initial Value Problems: Euler Method, Modified Euler Method & Boundary value problem: Finite Difference Method and Shooting Method, Convergence and Stability)	
	38	Numerical solution of Ordinary Differential Equation (Initial Value Problems: Euler Method, Modified Euler Method & Boundary value problem: Finite Difference Method and Shooting Method, Convergence and Stability)	
	39	Numerical Solution of Partial Differentiation Equations	
14	40	Numerical solution of Ordinary Differential Equation (Initial Value Problems: Euler Method, Modified Euler Method & Boundary value problem: Finite Difference Method and Shooting Method, Convergence and Stability)	
	41	Numerical solution of Ordinary Differential Equation (Initial Value Problems: Euler Method, Modified Euler Method & Boundary value problem: Finite Difference Method and Shooting Method, Convergence and Stability)	
	42	Numerical Solution of Partial Differentiation Equations	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C2, C3, C4, C5
Final Exam	60%	CO 1	C2, C3
		CO 2	C4, C5
		CO 3	C3
Total Marks	100%		

REFERENCE BOOKS
1. Statistics and Data Analysis for Engineers and Scientists by Tanvir Mustafy, Md. Tauhid Ur Rahman 2. Numerical Mathematical Analysis by – James b. Scarborough 3. Introductory Methods of Numerical Analysis by – S.S. Sastry 4. Numerical Methods for Scientific And Engineering Computation by- Jain, Iyengar, Jain 5. Numerical Methods using MATLAB (4th Edi.) by John H Mathews and Kurtis K Fink 6. Fundamentals of Engineering Numerical Analysis by Parviz Moin (2010)

Fall Semester L-2, T-II

COURSE INFORMATION			
Course Code Course Title	: CE 208 : Quantity Surveying	Lecture contact hours Credit hours	: 3.00 : 1.50
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course is a hand on training for estimating quantity and cost for different components of various civil engineering infrastructures which will be helpful for the students in their professional field later on.			
OBJECTIVE			
• To gain knowledge on the basics of estimation of different types of structures.			
COURSE CONTENT			
Earthwork excavation for roadway, earthwork computation from; estimation for residential building: estimation of slab, beam, column, footing; analysis of rates, specifications, costing of residential building; estimation and costing of septic tank; estimation and costing of underground water reservoir; estimation and costing of retaining wall; estimation and costing of slab culvert; computer aided quantity estimation; construction site survey and estimation.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Summarize** the total amount of earthwork required for road construction.	√											
2	**Estimate** the total material and cost required for different components of a residential building, different civil engineering structures	√											

	such as culvert, septic tank, water reservoir and retaining wall.												
3	**Work** effectively as an individual and also as a member of a team in checking the market price and quality assessment of different construction materials.									√			

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Summarize** the total amount of earthwork required for road construction.	1	C2	1		4,6	Class Assessment/Report/Quiz
CO2	**Estimate** the total material and cost required for different	1	C2	1		4,6	Class Assessment/Report/ Quiz

	components of a residential building, different civil engineering structures such as culvert, septic tank, water reservoir and retaining wall.						
CO3	**Work** effectively as an individual and also as a member of a team in checking the market price and quality assessment of different construction materials.	9	C3			6	Project (Market Survey)

<u>Knowledge Profile (K)</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

<u>Complex Engineering Problem (P)</u>:

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

<u>Complex Engineering Activities (A)</u>:

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

<u>Bloom's Taxonomy Levels</u>:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 11 weeks) Class assessment (1 hours/week X11 weeks)	22 11
Guided Learning Assessment Preparation (1.0 hours/week x 11 weeks)	11
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for quiz	08 04
Assessment Quiz Presentation	03 01
Total	60

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Earthwork excavation for roadway, earthwork computation from spot levels	Class Assessment/ Report
2	2	Estimation for residential building: One Storied residential building. Analysis of rates, specifications, costing of residential building	
3	3		
4	4		
5	5		
6		Mid Quiz	Quiz
7	6	Estimation of RCC for footing, column	Class Assessment/ Report
8	7	Estimation of RCC for beam	
9	8	Estimation of RCC for slab	
10	9	Estimation of septic tank and underground water reservoir	
11	10	Estimation of retaining wall	
12	11	Estimation of slab culvert	
13		Project presentation	Presentation

14		Final Quiz	Quiz

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Class Assessment/ Report	50%	CO1, CO2	C2
Presentation	10%	CO3	C3
Quiz	40%	CO1, CO2	C2
Total Marks	100%		

REFERENCE BOOKS

1. Estimating by – Abul Faraz Khan
2. Quantity Surveying: A Practical Guide for the Contractor's QS by Donald Towey.
3. Estimating & Costing in Civil Engineering by – Dutta
4. PWD Schedule of Rate

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code Course Title	: CE 210 : GIS and Remote Sensing	Lecture contact hours Credit hours	: 3.00 : 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This is a hand on training course for GIS and remote sensing. In this course students will be introduced to basic functions and analysis of GIS. Students will be also practice using GIS software for conducting spatial analysis.

OBJECTIVE

- To understand basic functions of GIS
- To understand common formats of GIS data like shapefiles, raster, and geodatabases.
- To produce maps for basic GIS analysis
- To utilize GIS software for conducting spatial analysis

COURSE CONTENT

GIS: basic concepts, location & spatial data, GIS data source (vector & raster data), Map Projection System; use and application of GIS in civil engineering aspects; Features of Arc GIS, Hands-on exercises using Arc GIS, Google Earth and related software.

Remote Sensing: Introduction to satellite images, Classification of indices, Georeferencing and Digitization of satellite images.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Define** the fundamental concepts and practices of Geographic Information Systems (GIS)	√											
2	**Apply** basic graphic and data visualization concepts such as colour theory, symbolization	√											
3	**Define** the fundamental	√											

	concepts and practices of Geographic Information Systems (GIS)												
4	**Apply** basic GIS and remote sensing analysis tools to address geospatial problems and/or research questions.					√							

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Define** the fundamental concepts and practices of Geographic Information Systems (GIS)	1	C1	1		1	Class Assessment/ Quiz
CO2	**Apply** basic graphic and data visualization concepts such as colour theory, symbolization	1	C3	1		4,5	Class Assessment/ Quiz
CO3	**Define** the fundamental concepts and practices of Geographic Information Systems (GIS)	1	C2	1		1	Class Assessment/ Quiz
CO4	**Apply** basic GIS and remote sensing analysis tools to address geospatial	5	C3	3		4,5	Class Assessment/ Quiz

	problems and/or research questions.						

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 11 weeks) Class assessment (1 hours/week X10 weeks)	 22 10
Guided Learning Assessment Preparation (1.0 hours/week x 10 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for quiz	 11 04
Assessment Quiz	 03
Total	60

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Basic concepts of GIS and spatial data; use and application of GIS in civil engineering aspects	Class Assessment
2	2	Introduction to GIS; Introduction to ArcGIS desktop software	
3	3	Map Design	

4	4	GIS Output	
5	5	Table Operation	
6	6	Geoprocessing	
7	7	Mid Quiz	Quiz
8	8	Introduction to Map, Map Projections, and Coordinate Systems; Georeferencing	Class Assessment
9	9	Digitizing and Editing	
10	10	Spatial Analysis	
11	11	Introduction to satellite images	
12	12	Classification of Indices	
13	13	Digitization of satellite images	
14	14	Final Quiz	Quiz

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Class Assessment	50%	CO1, CO2, CO3, CO4	C1, C2, C3
Quiz	50%	CO1, CO2, CO3, CO4	C1, C2, C3
Total Marks	100%		

REFERENCE BOOKS

1. “Introduction to Geographic Information System” by – Kang-Tsung Chang
2. “GIS Tutorial 1: Basic Workbook” by Wilpen L. Gorr, Kristen S. Kurland

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code Course Title	: CE 211 : Mechanics of Solids I	Lecture contact hours Credit hours	: 3.00 : 3.00

PRE-REQUISITE
CE 101
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
This is a basic mechanics course for civil engineering students. In this course, students will be introduced to basic solid mechanics including stress, strain, deformation, different loads, and behavior of structures under loading. This knowledge will be useful in various courses in the later semesters and various projects in their professional life.
OBJECTIVE
• Gain a fundamental understanding of the concepts of stress and strain by analysis of solids and structures. Study engineering properties of materials, force-deformation, and stress-strain relationship • Learn fundamental principles of equilibrium, compatibility, and principle of superposition in linear solids and structures • Analyse axial members, torsional members, and beams for axial force, shear force, torsion, and bending moment. • Determine stress, strain, and deformation of various structural components.
COURSE CONTENT
Concepts of stress and strain, generalized Hooke's law; constitutive relationships; plane stress & strain, stresses and deformation, resisting force, axial and transverse load; deformations due to tension, compression and temperature change; reactions, axial force, shear force and bending moments of beams; axial force, shear force and bending moment diagrams using method of section, summation approach and singularity function; bending of beam, bending with axial load, unsymmetric bending; shear stress in beam; shear Centre; closely coiled helical springs.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **calculate** deformation due to axial force and **plot** axial force diagrams.	√											
2	Ability to **determine** and **plot** axial force, shear force and bending moment		√										

	diagrams of structural members using different methods.												
3	Ability to **compute** bending stress in beams.		√										
4	Ability to **determine** shear stresses in beams.		√										

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **calculate** deformation and stress due to axial force, and **plot** axial force diagrams.	1	C3	1		2,3	Class Test, Mid-term, Pop quiz, Final Exam
CO2	Ability to **determine** and **plot** axial force, shear force and bending moment diagrams of structural members using different methods.	2	C3	1		2,3	Class Test, Mid-term, Pop quiz, Final Exam
CO3	Ability to **compute** bending stress in beams.	2	C3	1		2,3	Class Test, Mid-term, Pop quiz, Final Exam
CO4	Ability to **determine** shear stresses in beams.	2	C3	1		2,3	Class Test, Mid-Term, Final Exam

Knowledge Profile (K): **K1**: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature **Complex Engineering Problem (P)**: **P1**: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence **Complex Engineering Activities (A)**: **A1**: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity **Bloom's Taxonomy Levels**: **C1**: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create	
TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	15
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	36 22
Assessment Continuous Assessment Final examination	2 3
Total	120
TEACHING METHODOLOGY	
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)	

TEACHING SCHEDULE			
Week	**Lectures**	**Topics**	**Assessments**
1	1	Course overview & Fundamental principles and methods of structural mechanics	CT/ Assignment-1
	2	Concept of stress and strain	
	3	Equilibrium of deformed body	
2	4	Constitutive relationships	
	5	Plane stress & strain, stresses and deformation, resisting force, axial and transverse load	
	6	Supports, reactions and internal forces	
3	7	Plane stress & strain, stresses and deformation, resisting force, axial and transverse load	
	8	Mechanical properties of materials	
	9	Calculation of reactions, axial force, shear and bending moment	
4	10	Deformations due to tension, compression and temperature change	CT/ Assignment-2
	11	Deformations due to tension, compression and temperature change	
	12	Calculation of reactions, axial force, shear and bending moment	
5	13	Deformations due to tension, compression and temperature change	
	14	Deformations due to tension, compression and temperature change	
	15	Calculation of reactions, axial force, shear and bending moment	
6	16	Deformations due to tension, compression and temperature change	Mid Term/ Assignment-3
	17	Bending stresses in beams	
	18	Axial force, Shear force and bending moment diagrams of beams: Section method	
7	19	Bending stresses in beams	
	20	Bending stresses in beams	
	21	Axial force, Shear force and bending moment diagrams of beams: Section method	
8	22	Bending stresses in beams	

	23	Axial force, Shear force and bending moment diagrams of beams: Section method	
	24	Shear force and bending moment diagrams: Summation approach	
9	25	Bending stresses in beams	
	26	Shear force and bending moment diagrams: Summation approach	
	27	Shear force and bending moment diagrams: Summation approach	
10	28	Bending stresses in beams	
	29	Shear force and bending moment diagrams: Singularity function	
	30	Shear force and bending moment diagrams: Singularity function	
11	31	Bending stresses in beams	
	32	Shear stresses in beams	
	33	Shear stresses in beams	
12	34	Unsymmetric bending stress	CT/ Assignment-4
	35	Shear stresses in beams	
	36	Shear stresses in beams	
13	37	Unsymmetric bending stress	
	38	Shear flow, shear center and examples	
	39	Shear flow, shear center and examples	
14	40	Unsymmetric bending stress	
	41	Closely coiled helical springs	
	42	Closely coiled helical springs	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3, CO4	C2, C3
Final Exam	60%	CO 1	C3
		CO 2	C2

		CO 3	C3
		CO4	C3
Total Marks	100%		

REFERENCE BOOKS
1. Engineering Mechanics of Solids, Egor P. Popov, Prentice-Hall of India, 5th Edition. 2. Mechanics of Materials, Ferdinand P. Beer, E. Russell Johnston, Jonn T. DeWolf and David F. Mazurek, McGraw Hill, 8th Edition. 3. Mechanics of Materials, R C. Hibbeler, Pearson, 11th Edition 4. Mechanics of Materials, Ferdinand L Singer and Andrew Pytel, 4^{th} Edition. 5. Strength of Materials, W A Nash, 4^{th} Edition.

Fall Semester L-2, T-II

COURSE INFORMATION			
Course Code Course Title	: CE 212 : Structural Mechanics and Materials Sessional	Lecture contact hours Credit hours	: 1.50 : 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This is a material based sessional course for civil engineering students. In this course, students will learn how to determine different properties of materials, especially for construction-related materials like cement, aggregate, brick and steel reinforcement. Besides, students will be able to know and interpret different standards for materials testing.

OBJECTIVE

- To determine different engineering properties of materials like cement, aggregate, brick, metal etc.
- To learn the mix design of concrete.
- To determine different mechanical properties of mortar and concrete.
- To determine different mechanical properties of structural members like columns, beams, etc.
- To know and interpret different standards for materials testing.

COURSE CONTENT

Normal consistency, initial and final setting times, specific gravity of cement, compressive strengths of cement mortar; gradation, specific gravity, absorption capacity and unit weight of fine and coarse aggregates; design and testing of a concrete mix, and testing of bricks for compressive strength.

Tension, direct shear and impact tests of mild steel specimen; slender column test; static bending test; hardness test of metals; helical spring test.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **determine** the engineering properties of cement, aggregate, brick and metal.	√											
2	Ability to **design** mix design of concrete.			√									

3	Ability to **determine** different mechanical properties of mortar and concrete.	√											
4	Ability to **determine** different mechanical properties of structural members like columns, beams, etc.	√											

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’s Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **determine** the engineering properties of cement, aggregate, brick and metal.	1	C3			2,3	Report, Pop quiz, Final Quiz, VIVA
CO2	Ability to **design** mix design of concrete.	3	C3			2,5	Report, Pop quiz, Final Quiz, VIVA
CO3	Ability to **determine** different mechanical properties of mortar and concrete.	1	C3			2,3	Report, Pop quiz, Final Quiz, VIVA
CO4	Ability to **determine** different mechanical properties of structural members like columns, beams, etc.	1	C3			2,3	Report, Pop quiz, Final Quiz, VIVA

Knowledge Profile (K): **K1**: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature **Complex Engineering Problem (P)**: **P1**: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence **Complex Engineering Activities (A)**: **A1**: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity **Bloom's Taxonomy Levels**: **C1**: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create	
TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 13 weeks)	26
Guided Learning Tutorial/ Assignments (0.5 hours/week x 14 weeks)	7
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 14 10
Assessment Quiz + Viva	3
Total	60
TEACHING METHODOLOGY	
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)	

TEACHING SCHEDULE			
Week	**Lectures**	**Topics**	**Assessments**
1	1	Sieve analysis and Unit Weight of Coarse and Fine Aggregates	Report + Quiz + VIVA
2	2	Tension tests of a Mild Steel Specimen	
3	3	Specific gravity and Absorption Capacity of Coarse and Fine Aggregates	
4	4	Slender column test	
5	5	Design and Testing of a Concrete Mix	
6	6	Static bending test	
7	7	Normal consistency and specific gravity of cement	
8	8	Hardness test of metals	
9	9	Compressive strengths of cement mortar	
10	10	Impact tests of mild steel specimen	
11	11	Initial and Final Setting Times	
12	12	Helical Spring	
13	13	Testing of Bricks for Compressive Strength	
14	14	Quiz + VIVA	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Lab Report)	40%	CO 1	C1
		CO 2	C3
		CO 3	C1
		CO4	C1
Final Exam Quiz 1 & Quiz 2	50%	CO 1	C1
		CO 2	C3
		CO 3	C1
		CO4	C1
VIVA	10%	CO 1	C1
		CO 2	C3
		CO 3	C1
		CO4	C1
Total Marks	100%		

REFERENCE BOOKS
1. Engineering Mechanics of Solids by – Popov 2. Mechanics of Materials, Ferdinand P. Beer, E. Russell Johnston, Jonn T. DeWolf and David F. Mazurek, McGraw Hill, 8th Edition 3. Theory and Problems of Strength of Materials by -William A Nash 4. Laboratory Manual 5. 5. ASTM Internation Standards

Fall Semester L-2, T-II

COURSE INFORMATION

Course Code	: CE 213	Lecture contact hours	: 3.00
Course Title	: Mechanics of Solids II	Credit hours	: 3.00

PRE-REQUISITE

CE 211

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This is a continuation of CE 211 Mechanics of Solids I. In this course students will be able to gain fundamental knowledge on stress, strain, deformation, behaviour of beams and columns subjected to various loading.

OBJECTIVE

- To gain knowledge about the effect (state of stress) on beam due to combined loading and the transformation stresses and construction Mohr's circles of stress, subsequently understand the failure criteria by different theories of failure
- To understand Euler's buckling theory and its application in compressive members.
- To compute the deflection of beam by various methods.
- To develop the concept of strain energy for axial stress, flexural stress and shear stress.
- To understand the behaviour of cable under uniformly distributed load and concentrated load.

COURSE CONTENT (2021)

Stress transformation, Mohr's circle of stresses; beam deflection by direct integration method, moment area method; elastic strain energy and external work (Castigliano's Theorem), buckling of columns; concept of Euler's buckling of columns, elastic analysis of circular shafts, solid non-circular and thin walled tubular members subjected to torsion, flexible chords, cable theorem; cable and cable supported structures.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the stress and elastic strain energy under different loading (normal, shear, torsion etc)	√											
2	**Solve** the flexible cord, cable and cable supported structure		√										
3	**Apply energy principle to determine** the		√										

	deflection and rotation of flexural member												
4	**Understand** the fundamental buckling phenomena of axially loaded members		√										

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the stress and elastic strain energy under different loading (normal, shear, torsion etc)	1	L2	1		K3, P1	Class Test/ Mid-term/ Pop quiz/ Final Exam
CO2	**Apply cable theorem to solve** the flexible cord, cable and cable supported structure	1	L3	1		K3,K 4/ P1	Class Test/ Final Exam
CO3	**Determine** the deflection and rotation of flexural member	1	L3	1		K3, K4/P1	Class Test/ Mid-term/ Pop quiz/ Final Exam
CO4	**Understand** the fundamental buckling phenomena of axially loaded members	2	L2	1		K3/P1	Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence **<u>Complex Engineering Activities (A)</u>**: **A1**: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity **<u>Bloom's Taxonomy Levels</u>**: **C1**: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (4 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments (4 hours/week x 5 weeks)	18
Independent Learning Individual learning (1 hour lecture ≈1.0 hour learning) Preparation for tests and examination	33 22
Assessment Pop Quiz/Class Test/Mid-Term Exam Final examination	2 3
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Introduction and fundamentals of mechanics and mechanics of solids, Discussion on syllabus etc.	Class Test, Mid-term, Pop quiz, Assignment,Final Exam
	2	Elastic strain energy and external work	
	3	Deflection of beam: Derivation of 2nd and 4th order differential equation of deflection of beam(direct integration method)	
2	4	Deflection of beam using moment area method	
	5	Beam deflection examples	
	6	Deflection of beam using direct integration method: Simply supported with point loading, discontinuous UDL, Concentrated moment	

3	7 8	Examples on Moment area Method and double integration methods	
	9	Elastic strain energy	
4	10	External work	
	11	Examples	
	12	Castigliano’s Theorem for beam deflection	
5	13	Apply Castigliano’s theorem for truss deflection	
	14	Beam deflection examples	
	15	Truss deflection using Castigliano’s theorem	
6	16	Introduction to Buckling of column, related definitions and concepts. Derivation of Euler’s Load for columns with pin ends. Euler Load for columns with different end restraints.	
	17 18	Flexible chords	
7	19 20	Euler Formula and buckling of columns	
	21	Cable theorem	
8	22 23	Euler Formula and buckling of columns	
	24	Cable and cable supported structures	
9	25 26	Basic concept of transformation of stress. Transformation of stresses in 2D problems, Principal stresses in 2D problems, Maximum shear stresses in 2D problems	
	27	Cable theorem; cable and cable supported structures	
10	28	Examples of Transformation of stress	
	29 30	Elastic analysis of circular shafts subjected to torsion Thin walled tubular members subjected to torsion	
11	31	Mohr’s circle of stresses	
	32 33	Elastic analysis of circular shafts subjected to torsion	
12	34	Mohr’s circle of stresses	
	35 36	Solid non-circular subjected to torsion	
13	37	Mohr’s circle of stresses	
	38 39	Stress transformation and principle stress	
14	40	Mohr’s circle of stresses	
	41	Combination of composite-shape members subjected to torsion	

	42	Discussion	

ASSESSMENT STRATEGY

Components	Grading	CO	Blooms Taxonomy
Continuous Assessment (CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3, CO4	L2, L3
Final Exam	60%	CO1, CO2, CO3, CO4	L2, L3
Total Marks	100%		

REFERENCE BOOKS

1. Engineering Mechanics of Solids by – Popov
2. Advanced Strength and Applied Elasticity, 5th Edition, by A C Ugural and S K Fenster
3. Theory and Problems of Strength of Materials by -William A Nash
4. Strength of Materials by – Andrew Pytel, Ferdinand L. Singer (4th Edition)
5. Mechanics of Materials by – Laurson& Cox
6. Strength of Materials by – R.S. Khurmi

Fluid Mechanics

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code Course Title	: CE 261 : Fluid Mechanics	Contact hours Credit hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course will be helpful for students to learn how to analyze the fluid properties; fluid statics; kinematics of fluid flows; fluid flow concepts and basic equations- continuity equation, Bernoulli's equation, energy equation, momentum equation and forces in fluid flow; steady incompressible flow in pressure conduits, laminar and turbulent flow. In this course, students will also be introduced with the concept of general equation for fluid friction; empirical equations for pipe flow; minor losses in pipe flow; pipe flow problems- pipes in series and parallel, branching pipes, pipe networks etc. which will be useful in various projects in the following semesters and in their professional life.			
OBJECTIVE			
• To learn the basic properties of fluid and their applications • To understand the governing equations of fluid flow i.e. continuity, energy and momentum equations • To learn fundamental concepts in designing pipes and analysis of pipe networks			
COURSE CONTENT			
Fluid properties; fluid statics; kinematics of fluid flows; fluid flow concepts and basic equations- continuity equation, Bernoulli's energy equation, energy equation, momentum equation and forces in fluid flow; steady incompressible flow in pressure conduits, laminar and turbulent flow, general equation for fluid friction; empirical equations for pipe flow; major and minor losses in pipe flow; pipe flow problems- pipes in series and parallel, branching pipes, pipe networks			

COURSE OUTCOMESAND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the properties of fluids, and the significance of basic principles of fluid statics and application of hydrostatic law in determining forces on	√											

	surfaces and hydraulic structures												
2	**Understand** the basic principles of fluid kinematics and dynamics with specific emphasis on application of continuity equation, momentum equation etc.	√											
3	**Apply** the principles of Bernoulli's equation in measurement of discharge in pipes, and in other pipe flow problems		√										
4	**Apply** fundamental concepts in designing pipes and analysis of pipe networks			√									

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the properties of fluids, and the significance of basic principles of fluid statics and application of hydrostatic law in determining forces on surfaces and hydraulic structures	1	C2	1, 3		2	Pop Quiz, Assignment, Final Exam
CO2	**Understand** the basic principles of fluid kinematics and dynamics with specific emphasis on application of	1	C2	1, 3		2, 3	Class Test, Mid-Term, Final Exam

	continuity equation, momentum equation etc.						
CO3	**Apply** the principles of Bernoulli's equation in measurement of discharge in pipes, and in other pipe flow problems	1	C2	1, 3		2, 3	Class Test, Mid-Term, Final Exam
CO4	**Apply** the principles of Bernoulli's equation in measurement of discharge in pipes, and in other pipe flow problems	2	C3	1, 3		5	Class Test, Mid-Term, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	15
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	36 22
Assessment Continuous Assessment Final examination	2 3
Total	120

TEACHING METHODOLOGY			
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)			

TEACHING SCHEDULE			
Week	**Lectures**	**Topics**	**Assessments**
1	1	Introduction to Fluids and Fluid Mechanics	CT/ Assignment-1
	2	Definition of a fluid, shear, strain rate and viscosity	
	3	Different type of fluid flow	
2	4	Fluid properties: density, pressure etc	
	5	Dynamic and Kinematic viscosity	
	6	Surface Tension	
3	7	Fluid Statics: Pascal's law	
	8	Variation of pressure, Manometers	
	9	Forces on plane surface – concept and problem	
4	10	Forces on inclined surface	CT/ Assignment-2
	11	Forces on curved surface – concept	
	12	Forces on curved surface – problem	
5	13	Laminar and Turbulent Flows - Concept	
	14	Laminar and Turbulent Flows - Problem	
	15	Steady, Unsteady, Uniform, Non-uniform Flows	
6	16	1D, 2D and 3D Flows	Mid Term/ Assignment-3
	17	Streamlines, Path lines and Stream tubes - Concept	
	18	Streamlines and Path lines - Problem	
7	19	Continuity Equation for 1D Steady Flow	
	20	Stream Function, Potential Function and Flow net	
	21	Various Types of Energy in Fluid Flow	
8	22	Bernoulli's Equation	
	23	Kinetic Energy Coefficient – Concept and Problem	
	24	Energy Equation for 1D Steady Flow	
9	25	Total Energy Line and Hydraulic Grade Line, Cavitations	
	26	Head and Power - Pump	
	27	Head and Power - Turbine	

10	28	Linear Momentum Equation	
	29	Momentum Coefficient	
	30	Force Exerted on Pressure Conduits	
11	31	Force Exerted on Stationary Vane	
	32	Force Exerted on Moving Vane	
	33	Reaction of a Jet	
12	34	Flow in pressure conduits	CT/ Assignment-4
	35	General equation for fluid friction	
	36	Darcy-Weisbach and Hagen-Poisevielle Equation	
13	37	Major and minor losses in pipe flow	
	38	Pipes in series, expansions and contractions, loss coefficients	
	39	Pipes in parallel, equivalent lengths	
14	40	Branching pipes	
	41	Pipe networks, Hardy-Cross method	
	42	Pipe networks, multiple pipe systems	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3, CO4	C2, C3
Final Exam	60%	CO1	C2
		CO2	C2
		CO3	C2
		CO4	C3
Total Marks	100%		

REFERENCE BOOKS

1. Fluid Mechanics with Engineering Application by Franzini
2. Mechanics of Fluids by Merly Potter and David Wiggert (Shames Series)
3. Fluid Mechancis by Subrahmaniyam
4. Fluid Mechanics by Vennard and Street
5. Fluid Mechanics by Steeter and Wylie
6. Hydraulics, Fluid Mechanics and Hydraulic Machines by R S Khurmi

Fluid Mechanics Sessional

Spring Semester L-2, T-I

COURSE INFORMATION			
Course Code Course Title	: CE 262 : Fluid Mechanics Sessional	Contact hours Credit hours	: 3.00 : 1.50
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
It is a sessional course where students can have a hand on experiment about the centre of pressure; proof of Bernoulli's theorem; flow through venturimeter; flow through orifice; coefficient of discharge; coefficient of resistance; flow over v-notch; flow over sharp-crested weir; fluid friction in pipe etc. which will be useful in their professional life.			
OBJECTIVE			
• To understand the basic principles of fluid mechanics • To apply the basic principles to solve hydraulic engineering problems • To apply the theoretical knowledge to carry out experimental investigations of fluid problems			
COURSE CONTENT			
Centre of pressure; proof of Bernoulli's theorem; flow through venturimeter; flow through orifice; coefficient of discharge; coefficient of resistance; flow over v-notch; flow over sharp-crested weir; fluid friction in pipe; computer applications in solving pipe network problems.			

COURSE OUTCOMESAND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the basic principles of fluid mechanics.	√											
2	**Apply** the basic principles of fluid mechanics to solve hydraulic engineering problems.		√										
3	**Apply** the theoretical knowledge to carry out experimental investigations of fluid problems.		√										

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the basic principles of fluid mechanics.	1	C2			3	Lab Report + Quiz+ Viva
CO2	**Apply** the basic principles of fluid mechanics to solve hydraulic engineering problems.	2	C3			3, 6	Lab Report + Quiz + Viva
CO3	**Apply** the theoretical knowledge to carry out experimental investigations of fluid problems.	2	C3			3	Lab Report + Quiz

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 10 weeks)	30
Guided Learning	01

Report Writing (1 hour/week x 9 weeks)	
Independent Learning Individual learning	10 08
Assessment Quiz +Viva	2
Total	60

TEACHING METHODOLOGY

Lecture and Discussion, Experiments, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Introduction	Lab Manual, Lecture notes, Reference texts etc.
2	2	Determination of Centre of Pressure	
3	3	Proof of Bernoulli's Equation	
4	4	Flow through an Orifice	
5	5	Flow Over a Sharp crested Rectangular Weir	
6	6	Mid Quiz	
7	7	Flow through a Venturi Meter	
8	8	Flow over a V-notch	
9	9	Fluid Friction in a Pipe	
10	10	Determination of Co-efficient of Resistance for Change in Cross Section of Pipe	
11	11	Determination of Co-efficient of Discharge using Orifice Discharge Apparatus	
12	12	Final Quiz	
13	13	Viva	

ASSESSMENT STRATEGY

Components	Grading	CO	Blooms Taxonomy
Continuous Assessment (Conduct Lab Test & Lab Report)	40%	CO1, CO2, CO3	C2, C3
Quiz & Viva	60%	CO 1	C2
		CO 2	C3
		CO 3	C3
Total Marks	100%		

REFERENCE BOOKS
1. Fluid Mechanics with Engineering Application by Franzini 2. Fluid Mechanics and Hydraulic Machines by R k Bansal 3. Laboratory Manual

Fall Semester L-3, T-II

COURSE INFORMATION			
Course Code Course Title	: CE 300 : Civil Engineering Students' Internship Programme (CESIP)	Lecture contact hours Credit hours	: 3 Weeks : 1.5
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
In this course students will learn the details of construction works and different testing procedure related to civil engineering works. They can corelate their theoretical knowledge with practical application.			
OBJECTIVE			
• To observe the details of construction works /testing procedure • To identify any technical deviation in construction project from theoretical knowledge • To gain knowledge about construction management • To perform verbal presentation on the practical knowledge			
COURSE CONTENT			
Three weeks of internship in a civil engineering related job at an organization/firm as suggested by the department. Performance will be evaluated based on a presentation and a report submitted by the intern and evaluation of the reporting officer at the organization/firm.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **gain** practical professional experience in Civil Engineering	√											
2	Ability to **work** effectively as an individual and also as a member of a team during industrial attachment									√			

3	Ability to **develop** an appreciation of the breadth of Civil Engineering which helps to gain life-long learning capability												√
4	Ability to **perform** verbal presentation on the gained knowledge										√		

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **gain** practical professional experience in Civil Engineering	1	C2	-	1,2	6	Presentation, Report, VIVA
CO2	Ability to **work** effectively as an individual and also as a member of a team during industrial attachment	9	C3	-	-	6	Presentation, Report, VIVA
CO3	Ability to **develop** an appreciation of the breadth of Civil Engineering which helps to gain life-long learning capability	12	C3	-	1,2	6	Presentation, Report, VIVA
CO4	Ability to **perform** verbal presentation on the gained knowledge	10	C2	-	-	-	Presentation, Report, VIVA

<u>Knowledge Profile (K)</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

<u>Complex Engineering Problem (P)</u>:

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

<u>Complex Engineering Activities (A)</u>:

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

<u>Bloom's Taxonomy Levels</u>:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (4 hours/week x 2 weeks)	40
Guided Learning Report (2 hours/week x 1 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	7
Assessment Presentation + Viva	3
Total	60

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Weeks	Topic	Assessments
1	Visit of one industry	Presentation, Report, VIVA
2	Visit of another industry	
3	• Preparing report based on their gather knowledge during industrial training • Preparing presentation for shearing gathered knowledge • Preparation for viva	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Report)	50%	CO1	C2
		CO2	C3
		CO3	C3
		CO4	C2
Presentation & VIVA	50%	CO1	C2
		CO2	C3
		CO3	C3
		CO4	C2
Total Marks	100%		
REFERENCE BOOKS			
N/A			

CHAPTER 7

DETAILED SYLLABUS OF DEPARTMENTAL COURSES (CORE AND ELECTIVE)

7.1 Structural Engineering

Spring Semester L-3, T-I

Theoretical (Core)

COURSE INFORMATION			
Course Code Course Title	: CE 311 : Structural Analysis and Design I	Lecture contact hours Credit hours	: 4.00 : 4.00
PRE-REQUISITE			
CE 211 Mechanics of Solids I			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
It is the first course on structural analysis. In this course, students will learn how to analysis various structural components subjected to both static and moving loads. The analysis techniques learnt in this course will be useful in later courses where students will learn how to design different structural components.			
OBJECTIVE			
• To analyze statically determinate structures such as simple beams, cantilever beams, three hinged arches or frames and trusses. • To analyze statically indeterminate structures using simplified methods • To analyse the application of lateral load on structures using Bangladesh National Building Codes. • To analyze moving load on various types of structures			
COURSE CONTENT			
Stability and determinacy of structures; Analysis of statically determinate frames, gable frames, trusses and arches; Influence lines for beams, floor beams, determinate frames and trusses; Moving loads on beams, frames and trusses; Absolute Maximum moments for Wheel Loads; Analysis of suspension bridges. Wind and earthquake loads, code provisions as per BNBC. Approximate analysis of statically indeterminate structures: Mill bents, braced trusses; multi storied building frames analysis under vertical load and lateral load (Portal and cantilever method); Deflection of trusses and frames by virtual work method.			

COURSE OUTCOMES AND SKILL MAPPING

No	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Analyze** statically determinate structures.		√										
2	**Analyze** the effect of moving loads on statically determinate structures		√										
3	**Solve** statically indeterminate structures using approximate methods.		√										
4.	**Calculate** lateral loads of a multi-storied building.		√										

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Analyze** statically determinate structures.	2	C4	1,2		4	Class Test, Mid-term, Final Exam
CO2	**Analyze** the effect of moving loads on statically determinate structures	2	C4	1,2		4	Class Test, Mid-term, Final Exam
CO3	**Solve** statically indeterminate structures using approximate methods.	2	C4	1,2		4	Class Test, Mid-term, Final Exam

CO4	**Calculate** lateral loads of a multi-storied building.	2	C4	1,2		4	Class Test, Mid-term, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (4 hours/week x 14 weeks)	56
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	20
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 36 42
Assessment Continuous Assessment Final examination	 3 3
Total	160

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE			
Week	**Lectures**	**Topics**	**Assessments**
1	1	Earthquake load calculation as per BNBC-1993	CT/ Assignment-1
	2	Earthquake load calculation as per BNBC-1993 (contd)	
2	3	Earthquake load calculation as per BNBC-2014	
	4	Earthquake load calculation as per BNBC-2014 (contd)	
3	5	Wind load calculation as per BNBC-1993	
	6	Wind load calculation as per BNBC-1993 (contd)	
4	7	Wind load calculation as per BNBC-2014	CT/ Assignment-2
	8	Wind load calculation as per BNBC-2014 (contd)	
5	9	Approximate analysis of statically indeterminate truss	
	10	Approximate analysis of statically indeterminate truss (contd)	
6	11	Approximate analysis of statically indeterminate portal frame subjected to vertical load.	Mid Term/ Assignment-3
	12	Approximate analysis of statically indeterminate portal frame subjected to vertical load. (contd)	
7	13	Approximate analysis of statically indeterminate portal frame subjected to lateral load using portal method	
	14	Approximate analysis of statically indeterminate portal frame subjected to lateral load using portal method (contd)	
8	15	Approximate analysis of statically indeterminate portal frame using cantilever method	
	16	Approximate analysis of statically indeterminate portal frame using cantilever method (contd)	
9	17	Approximate analysis of tower truss	
	18	Approximate analysis of tower truss (contd)	
10	19	Approximate analysis of tower truss (contd)	
	20	Approximate analysis of tower truss (contd)	
11	21	Principle of work and energy. Principle of virtual work	
	22	Analysis and deflection calculation of truss using method of virtual work	

12	23	Introduction to Castigliano's theorem	CT/ Assignment-4
	24	Analysis and deflection calculation of truss using Castigliano's theorem	
13	25	Analysis and deflection calculation of beam using method of virtual work	
	26	Analysis and deflection calculation of frame using method of virtual work	
14	27	Analysis and deflection calculation of beam using Castigliano's theorem	
	28	Analysis and deflection calculation of frame using Castigliano's theorem	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3, CO4	C4
Final Exam	60%	CO 1	C4
		CO 2	C4
		CO 3	C4
		CO 4	C4
Total Marks	100%		

REFERENCE BOOKS

1. Structural Analysis, R C. Hibbeler, Prentice Hall, 8th Edition.
2. Indeterminate Structural Analysis, C K Wang, McGraw-Hill International Editions.
3. Matrix Analysis of Framed Structures, W. Weaver, Jr., James M. Gere, McGraw Hill, 2nd Edition.
4. Elementary Structural Analysis, Charles Head Norris, John Benson Wilbur and Senol Utku, McGraw Hill, 4th Edition.

Spring Semester L-3, T-I

Theoretical (Core)

COURSE INFORMATION			
Course Code Course Title	: CE 315 : Design of Concrete Structures I	Lecture contact hours Credit hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
In this course, students will learn to design different types of reinforced concrete slabs and beams under flexural and shear loading and to develop a strong foundation and design concepts of reinforced concrete building which will be beneficial for their future development and professionalism.			
OBJECTIVE			
• To gain knowledge on the basics of reinforced concrete structure. • To be able to design beam, slab, and shear reinforcement for beam. • To become aware of the proper safety and serviceability of reinforced concrete structures.			
COURSE CONTENT (2021)			
Fundamental behavior of reinforced concrete and loads on structure; introduction to strength and serviceability design and alternative design methods; flexural design of beams (singly reinforced, doubly reinforced, T-beam) using strength design method; shear, diagonal tension, and torsion of beams; Bond and anchorage of reinforcement and its detailing. Introduction to floor systems; structural forms, Design of one-way slabs; design of two-way edge supported slabs: using strip and alternate methods			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** fundamental design concepts of reinforced concrete	√											
2	**Analyze** the capacity of structural members against applied load considering the given material property.		√										
3	**Design** of slabs, and beams for flexure and shear load using code provisions			√									

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**:

Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** fundamental design concepts of reinforced concrete	1	C2	1	-	3	Class Test/ Mid-term/ Final Exam
CO2	**Analyze** the capacity of structural members against applied load considering the given material property.	2	C4	1, 3	-	3, 4	Class Test/ Mid-term/ Final Exam
CO3	**Design** of slabs, and beams for flexure and shear load using code provisions	3	C3	1,3, 5	-	5	Mid-term/ Pop quiz/ Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	18
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning)	33 22

Preparation for tests and examination	
Assessment Continuous Assessment Final examination	 2 3
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Introduction to Concrete, Reinforced Concrete, and Prestressed Concrete, Load according to BNBC	Class Test, Mid-term, Pop quiz, Final Exam
	2	Introduction to strength design and alternate design methods;	
	3	Safety provision of ACI Code, and serviceability.	
2	4	The fundamental assumption of RC concrete, Behavior under axial load	
	5	Materials properties under compression and tension, shrinkage, temperature, stress-strain curve, relaxation, etc.	
	6	Materials properties under compression and tension, shrinkage, temperature, stress-strain curve, relaxation, etc.	
3	7	Flexural analysis and design of beam, bending of a homogenous beam	
	8	RC concrete beam behavior.	
	9	Design example.	
4	10	Design of tension-reinforced rectangular beam, ACI Code Provisions	
	11	Under-reinforced, over-reinforced beam, minimum reinforcement ratio.	
	12	Design of singly reinforced beam	
5	13	Design example of singly reinforced beam	
	14	Design aid, practical consideration in the design of the beam,	
	15	Rectangular beam with tension and compression.	
6	16	Doubly Reinforced beam analysis	
	17	Design example of the doubly reinforced beam.	
	18	Design example of the doubly reinforced beam.	
7	19	T-beam analysis	
	20	Effective flange width, and strength analysis.	

	21	T-beam design example	
8	22	T-beam design example	
	23	Shear and diagonal tension in beams. Diagonal tension in homogenous elastic beams	
	24	Reinforced concrete beam without shear reinforcement	
9	25	ACI code provision for shear design	
	26	Design Example.	
	27	Design of web reinforcement.	
10	28	Design problems.	
	29	Analysis and design of slab, design of one-way slab.	
	30	Temperature shrinkage reinforcement, Design example of one-way slab.	
11	31	Design example and detailing of the one-way slab.	
	32	Behavior of two-way edge supported slab, column supported slab.	
	33	Design procedure of slab using various methods.	
12	34	Introduction to the moment coefficient method	
	35	Design of the two-way slab using the moment coefficient method.	
	36	Design of the two-way slab using the moment coefficient method.	
13	37	Design of the two-way slab using moment coefficient method.	
	38	Design and reinforcement detailing of a two-way slab.	
	39	Bond and anchorage and Development length, fundamentals of the flexural bond.	
14	40	Bond strength and development length, anchorage requirement for web RCC.	
	41	Bar cut-off and bent point of beams, Bar splices.	
	42	Design example of development length.	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C2, C3, C4
Final Exam	60%	CO 1	C2

		CO 2	C4
		CO 3	C3
Total Marks	100%		

REFERENCE BOOKS

1. Design of Concrete Structures by – Nilson, David & Dolan (15th Edition)
2. Reinforced Concrete: Mechanics and Design (6th Edi) by James Wight and James MacGregor
3. Design of Concrete Structures by – Nilson (12th Edition)
4. Structural Design Guide to the ACI Building Code (3rd Edition) - Rice, Hoffman, Gustafson, Gouwens
5. Bangladesh National Building Code – BNBC 2020

Fall Semester L-3, T-II

Theoretical (Core)

COURSE INFORMATION			
Course Code Course Title	: CE 317 : Design of Concrete Structures II	Lecture contact hours Credit hours	: 3.00 : 3.00

PRE-REQUISITE
CE 315

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
In this course, students will learn to design various components of reinforced concrete buildings, such as slabs with/without beams, short columns, slender columns, footing, pile caps, retaining walls, shear wall, etc and to develop a strong foundation and concepts of seismic resistant building and pre-stressed concrete which will be beneficial for their future development and professionalism.

OBJECTIVE
• To develop a strong foundation on reinforced concrete structure maintaining proper safety and serviceability requirement. • To be able to design various components of reinforced concrete structure, specially focusing on slab with/without beams, short column, slender column, footing, pile caps, retaining wall, shear wall etc. • To understand the basic concepts of pre-stressed concrete. • To be able to analyse pre-stressed concrete beam

COURSE CONTENT (2021)
Design of columns under uniaxial and biaxial loading, introduction to slender column; structural design of footings, pile caps; retaining wall, seismic detailing; shear wall subjected to axial load and flexure; Design of column supported slabs; Prestressed Concrete: concepts of prestressing; materials; anchorage systems; analysis and preliminary design of prestressed beam.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **analyze** and **design** super-structure components of a reinforced concrete building.			√									
2	Ability to **design** floor system of a reinforced concrete building			√									

3	Ability to **design** sub-structure components of a reinforced concrete building.			√									
4	Ability to **understand** basic concepts of pre-stressed concrete.	√											

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **analyze** and **design** super-structure components of a reinforced concrete building.	3	C4, C3	1		3, 5	Class Test, Mid-term, Pop quiz, Final Exam
CO2	Ability to **design** floor system of a reinforced concrete building	3	C3	1		5	Class Test, Mid-term, Pop quiz, Final Exam
CO3	Ability to **design** sub-structure components of a reinforced concrete building.	3	C3	1		5	Class Test, Mid-term, Pop quiz, Final Exam
CO4	Ability to **understand** basic concepts of pre-stressed concrete.	1	C2	1		3	Class Test, Mid-term, Pop quiz, Final Exam

<u>Knowledge Profile (K)</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

<u>Complex Engineering Problem (P)</u>:

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	56
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	15
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 56 27
Assessment Continuous Assessment Final examination	 3 3
Total	160

TEACHING METHODOLOGY

Lecture and Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Course overview & Fundamental behavior of reinforced concrete column	Class Test, Mid-term, Pop quiz, Assignment,Final Exam
	2	Introduction to axial compression	
	3	Structural design of footings	
	4	Structural design of footings	
2	5	Compression plus bending of rectangular columns & Interaction diagrams	
	6		
	7	Structural design of footings	
	8	Structural design of footings	
3	9	Compression plus bending of rectangular columns & Interaction diagrams and Balanced failure	
	10	Compression plus bending of rectangular columns & Interaction diagrams and Balanced failure	
	11	Structural design of footings	
	12	Structural design of pile caps	

4	13	Compression plus bending of rectangular columns & Interaction diagrams and Balanced failure	
	14	Compression plus bending of rectangular columns & Interaction diagrams and Balanced failure	
	15	Structural design of pile caps	
	16	Structural design of pile caps	
5	17	ACI code provisions for column design and Design aids	
	18	Biaxial bending	
	19	Design of RCC shear wall.	
	20	Design of RCC shear wall.	
6	21	Biaxial bending	
	22	Biaxial bending	
	23	Design of RCC shear wall.	
	24	Design of RCC shear wall.	
7	25	Slender columns	
	26		
	27	Seismic detailing.	
	28	Seismic detailing.	
8	29	Slender columns	
	30		
	31	Seismic detailing.	
	32	Seismic detailing.	
9	33	Introduction to floor systems, Design of column supported slabs	
	34	Introduction to floor systems, Design of column supported slabs	
	35	Introduction to Pre-stressed Concrete	
	36	1st Concept of pre-stressing	
10	37	Design of column supported slabs	
	38	Design of column supported slabs	
	39	2nd and 3rd Concept of pre-stressing	
	40	Type and Classification of Pre-stressing	
11	41	Design of column supported slabs	Class Test, Mid-term, Pop quiz, Assignment, Final Exam
	42	Design of column supported slabs	
	43	Stages of Loading in Pre-stressed Concrete Beam	
	44	Pre-stressed Concrete materials and anchorage systems.	
12	45	Design of column supported slabs	
	46	Design of column supported slabs	
	47	Pre-stressed Concrete materials and anchorage systems.	
	48	Pre-stressed Concrete materials and anchorage systems.	
13	49	Design of column supported slabs	
	50	Design of column supported slabs	

	51	Losses of Pre-stressed Concrete	
	52	Analysis of pre-stressed concrete beam.	
14	53	Design of column supported slabs	
	54	Design of column supported slabs	
	55	Preliminary Design of pre-stressed concrete beam.	
	56	Preliminary Design of pre-stressed concrete beam.	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3, CO4	C2, C3, C4
Final Exam	60%	CO1	C3, C4
		CO2	C3
		CO3	C3
		CO4	C2
Total Marks	100%		

REFERENCE BOOKS

1. Design of Concrete Structures, Arthur H. Nilson, David Darwin and Charles W. Dolan, McGraw Hill, 15th Edition.
2. Reinforced Concrete: Mechanics and Design, James Wight and James MacGregor, Pearson, 6th Edition.
3. Reinforced Concrete: A Fundamental Approach, Edward G. Nawy, Pearson, 5th Edition.
4. Design of Reinforced Concrete, Jack C. McCormac and James K. Nelson, John Wiley & Sons, Inc., 7th Edition.
5. Fundamentals of Reinforced Concrete by – Ferguson & Philip
6. Bangladesh National Building Code -BNBC 2020
7. Design of Prestressed Concrete Structure by – T.Y. Lin, Ned H. Burns (3rd Edition)
8. Prestressed Concrete Structures by Michael P Collins

Spring Semester L-4, T-I

Theoretical (Core)

COURSE INFORMATION			
Course Code Course Title	: CE 413 : Design of Steel Structures	Lecture contact hours Credit hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
It is a design course for steel structures, especially to learn how to design and analyze the tension and compression members, bolt and weld connections. In this course, students will also be introduced with the concept of buckling, flexural and shear strength, non-sway frame etc. which will be useful in various projects in the later semesters and in their professional life.			
OBJECTIVE			
• To develop a understanding of behavioural principles of structural steel. • To gain familiarity with limit state design philosophy. • To determine critical loading patterns for design. • To design steel components to resist applied loads and satisfy performance objectives. • To gain detailed knowledge pertaining to the requirements of American Institute of Steel Construction (ANSI/AISC) Standards.			
COURSE CONTENT			
Behavioural principles and design of structural steel; design of tension members, bolted and welded connections; compression members; residual stress, local buckling, effective length; flexural members; lateral torsional buckling; design of beam-columns; connection design, moment connections, column bases; detailing of steel structures.			

COURSE OUTCOMES AND SKILL MAPPING													
No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **design** various steel structural components including tension member, compression member, flexural member.		√										

2	Ability to **analyze** and **design** beam column connections of steel structures.			√									

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **design** various steel structural components including tension member, compression member, flexural member.	2	C3,C4	1,2		4, 5, 6	Class Test, Mid-term, Pop quiz, Final Exam
CO2	Ability to **analyze** and **design** beam column connections of steel structures.	3	C4	1,2		4, 5, 6	Class Test, Mid-term, Pop quiz, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42

Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	15
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	36 22
Assessment Continuous Assessment Final examination	2 3
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Behaviour of structural steel	CT/ Assignment-1
	2	Residual stress	
	3	Compression members	
2	4	Compression members	
	5	Local buckling	
	6	Compression members	
3	7	Compression members	
	8	Tension members	
	9	Lateral torsional buckling	
4	10	Lateral torsional buckling	CT/ Assignment-2
	11	Tension members	
	12	Lateral torsional buckling	
5	13	Design of beam-columns	
	14	Tension members	
	15	Design of beam-columns	
6	16	Design of beam-columns	Mid Term/ Assignment-3
	17	Tension members	
	18	Design of beam-columns	
7	19	Bolted and welded connections	
	20	Flexural members	

	21	Bolted and welded connections	
8	22	Flexural members	
	23	Bolted and welded connections	
	24	Flexural members	
9	25	Flexural members	
	26	Bolted and welded connections	
	27	Connection design	
10	28	Connection design	
	29	Bolted and welded connections	
	30	Connection design	
11	31	Connection design	
	32	Bolted and welded connections	
	33	Moment connections	
12	34	Moment connections	CT/ Assignment-4
	35	Detailing of steel structures, introduction to steel-concrete composite structures	
	36	Moment connections	
13	37	Column bases	
	38	Introduction to steel-concrete composite structures	
	39	Column bases	
14	40	Column bases	
	41	Advantages of composite construction	
	42	Various types of steel concrete composite columns	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2	C2, C3, C4
Final Exam	60%	CO 1	C3,C4
		CO 2	C4
Total Marks	100%		

REFERENCE BOOKS
1.Steel Structures: Design and Behavior by Salmon, Johnson and Malhas (5^{th}Edition) 2.Design of Steel Structures by – Gaylord, Gaylord 3.Limit States Design in Structural Steel by G L Kulak and G Y Grondin 4.AISC Manuals for Steel Constructions (13th Edition-2005)

Spring Semester L-4, T-I

Theoretical (Core)

COURSE INFORMATION			
Course Code Course Title	: CE 411 : Structural Analysis and Design II	Lecture contact hours Credit hours	: 3.00 : 3.00

PRE-REQUISITE
CE 311
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
In this course students will learn how to analysis various structural components of indeterminate subjected to both static and moving loads. Analysis technique learnt here will be useful in later courses where students will learn how to design different structural components.
OBJECTIVE
• To gain knowledge on analysing the statically indeterminate beams and frames by moment distribution, consistent deformation/ flexibility and stiffness methods. • To attain a workable knowledge on generating algorithms by using direct stiffness method using computer. • To gain knowledge on developing influence lines of statically indeterminate beams and frames.
COURSE CONTENT
Analysis of statically indeterminate beams and frames by moment distribution, consistent deformation/flexibility and stiffness methods; algorithms for implementing direct stiffness method using computer; influence lines of statically indeterminate beams and frames.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **analyze** statically indeterminate structures		√										
2	Ability to **develop** algorithms by using direct stiffness method		√										
3	Ability to **solve** influence lines for statically indeterminate structures		√										

Program Outcomes (PO):							
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning							
COURSE OUTCOMES AND GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **analyse** statically indeterminate structures	2	C4	1		2	Class Test, Mid-term, Pop quiz, Final Exam
CO2	Ability to **develop** algorithms by using direct stiffness method	2	C6	1,2,3		2, 3	Class Test, Mid-term, Pop quiz, Final Exam
CO3	Ability to **solve** influence lines for statically indeterminate structures	2	C4	1,2,3		2, 3	Class Test, Mid-term, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	15

Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 36 22
Assessment Continuous Assessment Final examination	 2 3
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	**Lectures**	**Topics**	**Assessments**
1	1	Course overview & Fundamental principles and methods of structural analysis	CT/ Assignment-1
	2	Moment distribution method – Beam	
	3	Stiffness methods	
2	4	Moment distribution method - Beam	
	5	Stiffness methods	
	6	Stiffness methods	
3	7	Moment distribution method - Beam	
	8	Stiffness methods	
	9	Stiffness methods	
4	10	Moment distribution method - Frame	CT/ Assignment-2
	11	Stiffness methods	
	12	Stiffness methods	
5	13	Moment distribution method - Frame	
	14	Stiffness methods	
	15	Direct stiffness methods	
6	16	Moment distribution method - Frame	Mid Term/ Assignment-3
	17	Direct stiffness methods	
	18	Direct stiffness methods	
7	19	Moment distribution method - Frame	
	20	Direct stiffness methods	
	21	Flexibility method	

8	22	Moment distribution method – Frame	
	23	Moment distribution method – Frame	
	24	Flexibility method	
9	25	Influence lines of statically indeterminate beams	
	26	Influence lines of statically indeterminate beams	
	27	Flexibility method	
10	28	Influence lines of statically indeterminate beams	
	29	Influence lines of statically indeterminate beams	
	30	Flexibility method	
11	31	Influence lines of statically indeterminate frames	
	32	Influence lines of statically indeterminate beams	
	33	Flexibility method	
12	34	Influence lines of statically indeterminate frames	CT/ Assignment-4
	35	Influence lines of statically indeterminate beams	
	36	Writing computer programs for framed structures	
13	37	Influence lines of statically indeterminate frames	
	38	Influence lines of statically indeterminate beams	
	39	Writing computer programs for framed structures	
14	40	Influence lines of statically indeterminate frames	
	41	Influence lines of statically indeterminate beams	
	42	Writing computer programs for framed structures	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C4, C6
Final Exam	60%	CO 1	C4
		CO 2	C6
		CO 3	C4
Total Marks	100%		

REFERENCE BOOKS
1. Structural Analysis, R C. Hibbeler, Prentice Hall, 8^{th} Edition. 2. Indeterminate Structural Analysis, C K Wang, McGraw-Hill International Editions. 3. Matrix Analysis of Framed Structures, W. Weaver, Jr., James M. Gere, McGraw Hill, 2^{nd} Edition. 4. Elementary Structural Analysis, Charles Head Norris, John Benson Wilbur and Senol Utku, McGraw Hill, 4^{th} Edition. 5. Structural Analysis by Aslam Kassimali (4^{th} Edition) 6. Bangladesh National Building Code (BNBC)-2020

Fall Semester L-3, T-II

Sessional (Core)

COURSE INFORMATION			
Course Code Course Title	: CE 316 : Concrete Structures Design Sessional I	Lecture contact hours Credit hours	: 3.00 : 1.50

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
This is the class room design sessional where students will be guided to design and prepare detailing of different components of a low rise masonry structure, slab bridge and balanced cantilever bridge.

OBJECTIVE

- To design a reinforced concrete low rise building.
- To design slab bridge and balanced cantilever bridge in real time project.
- To identify, formulate and solve real time RCC structures.

COURSE CONTENT (2021)
Design and detailing of a low-rise masonry building; Design and detailing of a slab bridge; Design and detailing of a balanced cantilever bridge.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the basic concepts of limit state design	√											
2	**Design** different elements of a low rise masonry building.			√									
3	**Design** of various structural components of a slab bridge and a balanced cantilever bridge.			√									

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the basic concepts of limit state design	1	C2	1		4, 5	Class Test, Mid-term, Pop quiz, Final Exam
CO2	**Design** different elements of a low rise masonry building.	3	C3	1, 5		5	Class Test, Mid-term, Pop quiz, Final Exam
CO3	**Design** of various structural components of a slab bridge and a balanced cantilever bridge.	3	C3	1		5	Assignment, Pop quiz

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom’s Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 12 weeks)	36
Guided Learning Report Writing (1 hours/week x 12 weeks)	12
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	3 3

Assessment Continuous Assessment Quiz	 3 3
Total	60

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1.	1.	Introduction to the design of a masonry building following BNBC guidelines and design of slab of a low rise masonry building.	Viva/ Oral Presentation /Final Quiz
2.	2.	Design of beam	
3.	3.	Design of stair	
4.	4.	Design of sunshade and lintel	
5.	5.	Design of foundation	
6.	6.	**Mid Quiz**	
7.	7.	Introduction on bridge design and Design of Slab Bridge with detailing	
8.	8.	Introduction to the design of a balanced cantilever bridge. Design of deck slab and railing of a balanced cantilever bridge.	
9.	9.	Analysis of Interior Girder for dead loads and live loads	
10.	10.	Analysis of Interior Girder for dead loads and live loads	
11.	11.	Design of Interior girder	
12.	12.	Design of Exterior girder and diaphragm	
13.	13.	Design of articulation.	
14.	14.	**Viva/ Oral Presentation/Final Quiz**	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class performance/assignments/ Report writing/ Presentation/Viva)	50%	CO1, CO2, CO3	C2, C3
Quiz	50%	CO 1	C2
		CO 2	C3
		CO 3	C3

Total Marks	100%		
REFERENCE BOOKS			
1. Design of Concrete Structures by Nilson (10th, 12th and 14th Edition) 2. Bangladesh National Building Code (BNBC) - 2020 3. AASHTO LRFD Bridge: Design Specifications 2012			

Spring Semester L-4, T-I

Sessional (Core)

COURSE INFORMATION			
Course Code Course Title	: CE 410 : Computer Aided Analysis and Design of Bridge Structures Sessional	Lecture contact hours Credit hours	: 3.0 : 1.5

PRE-REQUISITE

- CE-311: Structural Analysis & Design I
- CE-315: Design of Concrete Structures I
- CE-316: Concrete Structures Design Sessional I
- CE-317: Design of Concrete Structures II

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Before starting this course, students have already sufficient knowledge in analyze and design of simple concrete structures and their components through CE-315, CE 317, CE-311 and CE-411. In this course, students will learn how to analysis more complicated and mega structures like bridge where they will learn a combination of moving load, prestressing and application of Finite Element (FE) software.

OBJECTIVE

- To analyze the precast prestressed concrete bridge structures
- To design the structural components of bridge structures
- To apply modern tool for the analysis and design of bridge structures.

COURSE CONTENT

Structural idealization, Structural idealization, Analysis, design and detailing of prestressed concrete bridges (Deck, Girder, Railing, Pier, Pile cap) as per AASHTO LRFD guideline, and computer modelling of the full-scale bridge.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to analyse bridge structure including moving loads			√									
2	Ability to design components of bridge structure following established codes			√									

3	Ability to apply modern tools to accelerate the analysis and design of bridge structures					√							

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	Ability to analyse bridge structure	3	C4	1,3		4	Class Test, Mid-term, Pop quiz, Final Exam
CO2	Ability to design components of bridge structure	3	C4	1,3		5	Class Test, Mid-term, Pop quiz, Final Exam
CO3	Ability to apply modern tools to accelerate the analysis and design of structures	5	C5	1,5		6	Assignment

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)

Face to Face Learning Lecture (3 hours/week x 12 weeks)	36
Guided Learning Tutorial/ Assignments (1 hours/week x 6 weeks)	6
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 8 6
Assessment Quiz+Viva	4
Total	60

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Weeks	Lectures	Topic	Assessments
1	1	Introduction to the PC Girder Bridge and Project Description	Class Assessment, Continuous assessment, Quiz-1, Viva-1
2	2	Preliminary Design: Geometry Selection of Bridge Structure (PC Girder Bridge): Moving Loads on the Bridge Structures: HL-93	
3	3	Hand Calculation of Slab Design including crack width calculation	
4	4	Calculation of girder moment shear, distribution factor for shear and moment	
5	5	Load Combinations and critical design load, Girder Design for moment	
6	6	Girder design for moment, prestress strand, prestress loss, bearing pad design calc	
7	7	Girder Design of Shear, all reinforcement detailing and final submission list	
8	8	Quiz-1 & Viva-1	
9	9	Bridge Modelling Using FE Software Introduction to the MIDAS-Civil	
10	10	Geometry Assignment	
11	11	Dead Load, LL, Lane Assignment on the FE Model	
12	12	Load Combinations and analysis of the Model	
13	13	Design of the PC girder and its components	
14	14	Quiz-2 & Viva-2	

ASSESSMENT STRATEGY

Components	Grading	CO	Blooms Taxonomy
Continuous Assessment (Lab Report)	50%	CO1	C4
		CO2	C5
		CO3	C2, C3

Quiz 1 & Quiz 2	50%	CO1	C4
		CO2	C5
Total Marks	100%		

REFERENCE BOOKS

1.Bangladesh National Building Code (BNBC)-2020
2.AASHTO LRFD Bridge: Design Specifications 2012

Spring Semester L-4, T-I

Sessional (Core)

COURSE INFORMATION			
Course Code Course Title	: CE 414 : Steel Structure Design Sessional	Lecture contact hours Credit hours	: 1.5 : 1.5
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This is the class room design sessional where students will be guided to design and prepare detailing of different components, such as tension member, compression member, connections, column base, of a low-rise steel structure as well as an industrial building. Also, student will be able to model, analyze and design steel bridge using available software's which will help them in professional career.			
OBJECTIVE			
• To provide adequate knowledge about tools necessary for designing steel structures. • To analyse steel structures under gravity and lateral loads using hand calculation and computer program. • To make familiarize with local and international design codes. • To analyse and design of steel bridge using available computer program.			
COURSE CONTENT (2021)			
Analysis and design of a medium-rise steel frame building (preferably 7 storey) and a gable frame considering gravity and lateral loads; strength and serviceability check, design of individual members, connections and typical columns bases using available computer program (also check with hand calculation). Analysis and design of a steel bridge using computer software; superstructure design; lane assignment, load assignment including vehicle live load application, analysis, design check of structural components.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Analyse** steel frame building and industrial gable frame structures.		√										
2	**Design** of different components of structures, i.e., building and roof truss			√									

3	**Application** of computer program for analysis and design of steel buildings and bridge					√							

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Analyses** of integrated low rise building and industrial frame and its different components	2	C4	1		4	Class assessments/ Quiz/viva
CO2	**Design** of different components of structures, ie, building and roof truss	3	C3	1		5	Class assessments/ Quiz/viva
CO3	**Demonstrate** the application of modern tools for analysis and design of structures	5	C4	1		6	Class assessments/ viva

<u>Knowledge Profile (K)</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

<u>Complex Engineering Problem (P)</u>:

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

<u>Complex Engineering Activities (A)</u>:

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

<u>Bloom's Taxonomy Levels</u>:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (1hours/week x 10 weeks) Data analysis and calculation (1.5 hr/week X 10 weeks)	10 15

Guided Learning Report Writing (2 hour/week x 10 weeks)	20
Independent Learning Preparation for tests and examination	08
Assessment Quiz Viva Class Performance (0.25 hr/week X 10 weeks)	 2.5 2 2.5
Total	60

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lecture Topic	Assignments
1	Introduction to the steel frame design with ETABS 2020: Project Assignments	Lab reports in every class
2	Concept and Hand Calculation of Gable frame with pitched roof system	
3	Development of the gable frame Model in ETABS 2020: Geometry, Roofing and wind loading	
4	Analysis and Design of the gable frame: Strength and Serviceability check	
5	Hand Calculation of base plate, Purlin and roofing element design	
6	Development of 7-Storey Integrated model of steel frame using ETABS: Framing System: Geometry, Wind and Earthquake Loading	
7	Analysis of the building: Check the serviceability and design demands	
8	Quiz-1 and Viva	
9	Introduction to SAP 2000 with the analysis of a simple beam element: Project Assignment	
10	Influence lines, Modelling vehicle live load with lanes in SAP 2000	
11	Development of the 100m warren truss bridge: Geometry, loading and vehicle live load etc	

12	Calculation of dead load & wind load at different joint of warren truss, truss analysis using computer software and hand calculation	
13	Design of the truss bridge and its components	
14	Viva and Quiz-2	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment/ Viva/ Reports	40%	CO1, CO2, CO3	C3, C4
Quiz	60%	CO 1	C4
		CO 2	C4
		CO 3	C4
Total Marks	100%		

REFERENCE BOOKS

1. Steel Structures: Design and Behavior by Salmon, Johnson and Malhas (5th Edi)
2. Limit States Design in Structural Steel by G L Kulak and G Y Grondin
3. AASHTO LRFD Bridge: Design Specifications 2012

Fall Semester L-4, T-II

Sessional (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 412 : Concrete Structures Design Sessional II	Lecture contact hours Credit hours	: 3.0 : 1.5

PRE-REQUISITE

- CE-311: Structural Analysis & Design I
- CE-315: Design of Concrete Structures I
- CE-316: Concrete Structures Design Sessional I
- CE-317: Design of Concrete Structures II

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

It is a design course for reinforced concrete structures, especially to learn how to analyze and design different components of RC building by hand and apply modern tools like computer software to accelerate the analysis and design process. Students will understand the general structural behaviour and design concepts of RC building structures.

OBJECTIVE

- To develop a deep understanding of behavioural principles of reinforced concrete frame structure.
- To analysis and design of different components of RC buildings under wind and seismic application.
- To apply Finite Element based tools to check and accelerate the analysis and design of building structures.

COURSE CONTENT

Analysis and design of RC moment frame buildings for wind and seismic application; multi-storeyed RC buildings with shear wall and mat foundation for wind and seismic application; Analysis and Design using Finite Element Software like ETABS and SAP2000.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **analyse a** frame structure for combined gravity and lateral.		√										
2	Ability to **design** various components of concrete and steel moment frame building subjected to gravity and lateral loads.			√									

3	Ability to **apply modern tools** for analysis and design of structures and individual components					√							

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **analyse** an RC moment frame building for lateral loads.	2	C4	1,3		4	Class Test, Mid-term, Pop quiz, Final Exam
CO2	Ability to **design** various components of RC moment frame building.	3	C5	1,2		5	Class Test, Mid-term, Final Exam
CO3	Ability to **apply modern tools** for analysis and design of structures and individual components	5	C5	1,5		5	Quiz and Continuous Assessment

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)

Face to Face Learning Lecture (3 hours/week x 12 weeks)	36
Guided Learning Tutorial/ Assignments (1 hours/week x 6 weeks)	6
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	8 7
Assessment Quiz+Viva	3
Total	60

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Weeks	Lectures	Topic	Assessments
1	1	• Introduction • Acquaintance with individual data • Load Calculation for slab and beam	Assignment, Continuous Assessment, Quiz-1
2	2	• Slab design	
3	3	• Earthquake and Wind load Calculation	
4	4	• Moment Distribution on frame	
5	5	• Design of the beam and column	
6	6	• Design of Pile and Pile Cap	
7	7	• Quiz 1, Viva	
8	8	• Introducing the building plan and the individual design data to students.	Assignment, Continuous Assessment, Quiz-2
9	9	• Acquaintance with the interface of ETABS 2015 • Defining grid, material properties and section properties	
10	10	• Complete modelling of an 8 storied residential building.	
11	11	• Assigning gravity load with appropriate load combinations to the model and interpretation of the analysis results. • Assigning lateral loads according to BNBC 2020. • Interpretation of the analysis results and checking the design output parameters with hand calculation.	
12	12	• Design of foundation	
13	13	• Design of Shear wall	
14	14	• Mid Term Quiz + Viva	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Lab Report)	40%	CO1	C4
		CO2	C5
		CO3	C3
Quiz 1 & Quiz 2	60%	CO1	C4
		CO2	C5
Total Marks	100%		

REFERENCE BOOKS

1.Design of Concrete Structures by – Winter &Nilson (10^{th} Edition)
2.Design of Concrete Structures by – Nilson (12^{th} Edition)
3.Design of Bridge Structures by – Jayaram
4.Bangladesh National Building Code (BNBC)’20

Fall Semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 429 : Design of Steel Concrete Composite Structure	Lecture contact hours Credit hours	: 2.00 : 2.00
PRE-REQUISITE			
CE 317 Design of Concrete Structures II, CE 319 Design of Steel Structures			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
In this course students will learn about different types of steel-concrete composite columns and floor system. They will also learn to analyze and design different components of composite structures.			
OBJECTIVE			
• To understand the behavior of steel concrete composite structure • To evaluate the load carrying capacity of various types of steel concrete composite columns • To analyze and design of steel concrete floor system			
COURSE CONTENT			
Introduction to steel-concrete composite structures; advantages of composite construction; interaction between steel and concrete, shear connectors, elastic analysis of composite beams, beam-column connections, behaviour of different types of composite columns, axial load capacity and interaction diagrams for composite columns			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **understand** the behavior of steel concrete composite structure	√											
2	Ability to **evaluate** the load carrying capacity of various types of steel concrete composite columns		√										
3	Ability to **analyze** and design of steel concrete floor system			√									

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **understand** the behavior of steel concrete composite structure	1	C2	1,2		4	Class Test, Mid-term, Final Exam
CO2	Ability to **evaluate** the load carrying capacity of various types of steel concrete composite columns	2	C5	1,2		4	Class Test, Mid-term, Final Exam
CO3	Ability to **analyze** and design of steel concrete floor system	3	C4	1,2		4	Class Test, Mid-term, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks)	28
Guided Learning	10

Tutorial/ Assignments (2 hours/week x 5 weeks)	
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	24 13
Assessment Continuous Assessment Final examination	2 3
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Weeks	Lectures	Topics	Assessments
1	1	Introduction to Steel Concrete Composite Structure, Advantages of composite construction	Lecture notes, Reference texts, etc.
	2	Advantages and disadvantages different types of composite column, Shear connector	
2	3	Load carrying capacity of FEC column under axial compression	
	4	Load carrying capacity of FEC column under axial compression	
3	5	Load carrying capacity of FEC column under axial tension	
	6	Load carrying capacity of eccentrically loaded FEC column	
4	7	Load carrying capacity of eccentrically loaded FEC column	
	8	Load Transfer mechanism of FEC column	
5	9	Load Transfer mechanism of FEC column	
	10	Load carrying capacity of CFT column under axial compression	
6	11	Load carrying capacity of CFT column under axial compression	
	12	Load carrying capacity of CFT column under axial tension	

7	13	Load carrying capacity of eccentrically loaded CFT column	
	14	Load carrying capacity of eccentrically loaded CFT column	
8	15	Load Transfer mechanism of CFT column	
	16	Load Transfer mechanism of CFT column	
9	17	Load carrying capacity of PEC column under axial compression	
	18	Introduction to steel concrete floor system	
10	19	Construction stages, Design Consideration, AISC design guideline	
	20	Behavior and analysis of composite beams	
11	21	Behavior and analysis of composite beams	
	22	Behavior and analysis of composite beams	
12	23	Behavior and analysis of composite beams	
	24	Composite beam design	
13	25	Composite beam design	
	26	Composite beam design	
14	27	Composite girder design	
	28	Composite girder design	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3, CO4	C2,C4,C5
Final Exam	60%	CO 1	C2
		CO 2	C5
		CO 3	C4
Total Marks	100%		

REFERENCE BOOKS
1. Steel Structures: Design and Behavior by Salmon, Johnson and Malhas (5th Edi) 2. Limit States Design in Structural Steel by G L Kulak and G Y Grondin 3. AISC design guide 2014

Fall Semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 415 : Prestressed Concrete	Lecture contact hours Credit hours	: 2.00 : 2.00
PRE-REQUISITE			
CE 317			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
It is an advanced design course for prestrssed concrete structures, provides knowledge about prestressing materials, loss estimation of prestressed concrete member and analysis and design of section for flexure, bond and bearing. Students can familiar with composite sections, beam deflections, layout of cable and partial prestressing etc. In this course, students will also be introduced about the design prestreesd concrete beam with simple and continuous span, as per AASHTO Code as well as design consideration for prestressed concrete pipes, piles, poles and railway sleepers which will be useful in various projects in the later semesters and in their professional life.			
OBJECTIVE			
• To be able to understand mechanism of prestressed concrete structure. • To be able to perform analysis and design of prestressed concrete members. • To be able to design prestressed beam with (Simple and continuous span) according code provision. • To gain knowledge about the design consideration of prestressed concrete pipes, poles and railway sleepers.			
COURSE CONTENT			
Prestressed Concrete: concepts of prestressing; materials; anchorage systems; loss of prestress; analysis of sections for flexure, shear, bond and bearing; analysis of end block and composite sections; beam deflections; cable layout; partial prestress. Design of prestressed concrete beams for simple and continuous spans; ideas about use of AASHTO – PCI sections for standard spans; design considerations for prestressed concrete pipes, piles, poles and railway sleepers.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **understand** the mechanism of prestressed concrete	√											

	structure and loss estimation.												
2.	Ability to **Analyze** the section for flexure, shear and bond including end block.		√										
3	Ability to **analyze** the composite section, and **determine** beam deflections.				√								
4	Ability to **design** prestressed concrete beam as per code.			√									
5	**Understand** the design considerations for prestressed concrete pipes, piles, poles and railway sleepers.	√											

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **understand** the mechanism of prestressed concrete structure and loss estimation.	1	C5	1		5	Class Test, Mid-term, Pop quiz
CO2	Ability to **analyze** the section for flexure, shear and bond including (End Block)	2	C3	1,2,3		4, 5	Class Test, Mid-term, Pop quiz, Final Exam
CO3	Ability to **analyze** the composite section, and **determine** beam deflections.	4	C2, C3	1,3		4,5	Assignment, Pop quiz, Class Test Final Exam

CO4	Ability to **design** prestressed concrete beam with (Simple and continuous span) as per code.	3	C3	1,3,5		4,5	Class Test, Mid-term, Pop quiz, Final Exam
CO5	**Understand** the design considerations for prestressed concrete pipes, piles, poles and railway sleepers.	1	C5	1		4	Class Test, Pop quiz, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (4 hours/week x 3 weeks)	12
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	20 15
Assessment Continuous Assessment Final examination	2 3
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE			
Week	**Lectures**	**Topics**	**Assessments**
1	1	Basic Concept of Prestressing methods.	CT/ Assignment-1
	2	Basic Concept of Prestressing methods.	
2	3	Prestressing materials, Anchorage system.	
	4	Loss of prestress for beam.	
3	5	Loss estimation of prestress beam (Math)	
	6	Analysis of section for flexure.	
4	7	Analysis of section for flexure.	CT/ Assignment-2
	8	Analysis of section for shear	
5	9	Analysis of section for bond and bearing.	
	10	End Block analysis of member.	
6	11	Analysis of Composite section.	Mid Term/ Assignment-3
	12	Analysis of Composite section.	
7	13	Analysis of Composite section.	
	14	Beam deflections; cable layout; partial prestress	
8	15	Beam deflections; cable layout; partial prestress	
	16	Design of prestressed concrete beams for simple spans.	
9	17	Preliminary Design of beam.	
	18	Design of prestressed concrete beams for simple spans;	
10	19	Design of prestressed concrete beams for simple spans;	
	20	Design of prestressed concrete beams for continuous spans;	
11	21	Design of prestressed concrete beams for continuous spans;	
	22	Design of prestressed concrete beams for continuous spans;	
12	23	Ideas about use of AASHTO – PCI sections for standard spans;	CT/ Assignment-4
	24	Ideas about use of AASHTO – PCI sections for standard spans;	
13	25	Design considerations for prestressed concrete pipes, piles.	

	26	Design considerations for prestressed concrete pipes, piles.	
14	27	Design considerations for prestressed concrete poles and railway sleepers.	
	28	Design considerations for prestressed concrete poles and railway sleepers.	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3, CO4, CO5	C2, C3, C5
Final Exam	60%	CO 2	C3
		CO 3	C2, C3
		CO 4	C3
		CO5	C5
Total Marks	100%		

REFERENCE BOOKS

1. Design of Prestressed Concrete Structure by – T.Y. Lin, Ned H. Burns (3rd Edition)
2. Prestressed Concrete Structures by Michael P Collins
3. AASHTO-LRFD CODE 2012.

Fall Semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 417 : Design of Concrete Structures III	Lecture contact hours Credit hours	: 2.00 : 2.00

PRE-REQUISITE
CE 315, CE 317

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
It is an advanced design course for reinforced concrete structures, provides knowledge about design and analyzes of structural component for torsion, design of slab system, deep beam design, slender column etc. In this course, students will also be introduced about the design and detail drawing of reinforcement at joint and lift cores, diaphragm which will be useful in various projects and in their professional life.

OBJECTIVE

- To gain knowledge on the advance topic of reinforced concrete structure.
- To become skilled at the design of slab and torsion for beam.
- To become aware of the lateral load resisting design and detailing of concrete structures.

COURSE CONTENT
Analysis and design for torsion; design of one way and two-way joist slabs with or without beam on the column line; slender columns; strut-and-tie models (design of deep beam), design of reinforcement at joints; design and detailing of lateral load resisting components. lift cores, diaphragm etc.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **Analyse** the components of structure under torsion.		√										
2	Ability to **design** the structural components of a reinforced concrete slabs and columns.		√										
3	Ability to **produce** details structural drawings for lateral load resisting components.		√										

4	Ability to **apply** the strut-and-tie models concept for deep beam design.	√											

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **Analyse** the components of structure under torsion.	2	C4	1, 2		3, 4, 5	Class Test, Mid-term, Pop quiz, Final Exam
CO2	Ability to **Design** the structural components of a reinforced concrete slabs and columns.	2	C4	1, 2		3, 4, 5	Class Test, Mid-term, Pop quiz, Final Exam
CO3	Ability to **produce** details structural drawings for lateral load resisting components.	2	C4	1,5		3, 4, 5	Class Test, Mid-term, Pop quiz, Final Exam
CO4	Ability to **apply** the strut-and-tie models concept for deep beam design.	1	C3	1,5		3, 4, 5	Mid-term, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	24 13
Assessment Continuous Assessment Final examination	2 3
Total	80

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Analysis of Structural Component for Torsion	CT/ Assignment-1
	2	Analysis of Structural Component for Torsion	
2	3	Design of Components for Torsion.	
	4	Design of Components for Torsion.	
3	5	Preliminary Guideline of one way joist slab system	
	6	Preliminary Guideline of two way joist slab system	
4	7	Design of slab with beams on column line	
	8	Design of slab with beams on column line	
5	9	Design of slab with beams on column line	
	10	Design of slab without beams on column line	
6	11	Design of slabs without beams on column line.	Mid Term/ Assignment-2
	12	Design of slabs without beams on column line.	
7	13	Design of Slender Column.	
	14	Design of Slender Column.	
8	15	Design of Deep Beam (Strut and Tie Model)	
	16	Design of Deep Beam (Strut and Tie Model)	

9	17	Design of Deep Beam (Strut and Tie Model)	
	18	Design of Deep Beam (Strut and Tie Model)	
10	19	Design of reinforcement at joints	
	20	Design of reinforcement at joints	
11	21	Design of reinforcement at joints	
	22	Design of reinforcement at joints	
12	23	Design lateral load resisting components. lift cores,	CT/ Assignment-3
	24	Design lateral load resisting components. lift cores	
13	25	Guideline of detailing of lift cores	
	26	Guideline of detailing of lift cores	
14	27	Design of diaphragm	
	28	Design of diaphragm	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C4
Final Exam	60%	CO 1	C4
		CO 2	C4
		CO 3	C4
		CO 4	C3
Total Marks	100%		

REFERENCE BOOKS

1. Design of Concrete Structures, Arthur H. Nilson, David Darwin and Charles W. Dolan, McGraw Hill, 15th Edition.
2. Reinforced Concrete: Mechanics and Design, James Wight and James MacGregor, Pearson, 6th Edition.
3. Reinforced Concrete: A Fundamental Approach, Edward G. Nawy, Pearson, 5th Edition.
4. Design of Reinforced Concrete, Jack C. McCormac and James K. Nelson, John Wiley & Sons, Inc., 7th Edition.
5. Bangladesh National Building Code (BNBC) 2020

Fall Semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 419 : Introduction to Finite Element Method	Lecture contact hours Credit hours	: 2.00 : 2.00
PRE-REQUISITE			
CE 411			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The course provides basic knowledge on the application of finite element analysis to engineering applications in linear structural mechanics. The course analyses critically problems involving one, two and three-dimensional idealizations. The topics covered include steps in the finite element modelling process, behaviour of spring, truss, beam, plane stress/strain and three-dimensional finite element modelling approaches in structural mechanics.			
OBJECTIVE			
• Implement the basics of FEM to relate stresses and strains. • Formulate Integral Formulations and their application in the Finite Element Method. • Solve 1D, 2D and 3D problems using the Finite Element Analysis approach.			
COURSE CONTENT			
Introduction to finite element method as applied to stress analysis problems; basic equations in elasticity, matrix displacement formulation, element shapes, nodes, nodal unknowns and coordinate system, shape functions, strain displacement matrix, methods for assembling stiffness equations e.g. direct approach, Galerkin's method, virtual work method; introduction to isoparametric formulation; discritization of a structure and mesh refinement, one-dimensional stress deformation and two-dimensional plane stress and plane strain analysis of stress-deformation problems; integral formulations, weighted residual methods, variational approach; numerical integration and computer application.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** various concepts used in finite element method	√											
2	**Analyze** the one-dimensional problems using various methods		√										

3	**Analyze** the two-dimensional problems		√										

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** various concepts used in the finite element method	1	C2	1, 3		2	Class Test, Mid-term, Pop quiz, Final Exam
CO2	**Analyze** the one-dimensional problems using various methods	2	C4	1		3	Class Test, Mid-term, Pop quiz, Final Exam
CO3	**Analyze** the two-dimensional problems	2	C4	1		3	Class Test, Mid-term, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)

Face to Face Learning Lecture (2 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	24 13
Assessment Continuous Assessment Final examination	2 3
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Introduction to finite element analysis, approach method	CT/ Assignment-1
	2	Introduction to finite element analysis, approach method	
2	3	Direct methods, stiffness method, elements and nodes	
	4	Direct methods, stiffness method, elements and nodes	
3	5	One-dimensional bar members, local and global coordinate systems, global matrix	
	6	One-dimensional bar members, local and global coordinate systems, global matrix	
4	7	One-dimensional bar members, local and global coordinate systems, global matrix	
	8	One-dimensional bar members, local and global coordinate systems, global matrix	
5	9	One-dimensional bar members, local and global coordinate systems, global matrix	Mid Term Exam/ Assignment – 2
	10	One-dimensional bar members, local and global coordinate systems, global matrix	
6	11	Two-Dimensional (2D) Element	
	12	Two-Dimensional (2D) Element	

7	13	Two-Dimensional (2D) Element	
	14	Two-Dimensional (2D) Element	
8	15	Basic concepts of plane stress and plane strain	
	16	Basic concepts of plane stress and plane strain	
9	17	Modeling techniques used in finite element analysis	CT/ Assignment-3
	18	Modeling techniques used in finite element analysis	
10	19	Integral Formulations and Their Application in The Finite Element Method	
	20	Integral Formulations and Their Application in The Finite Element Method	
11	21	Integral Formulations and Their Application in The Finite Element Method	
	22	Integral Formulations and Their Application in The Finite Element Method	
12	23	Three-Dimensional Stress Analysis	
	24	Three-Dimensional Stress Analysis	
13	25	Introduction to Finite Element Software	
	26	Introduction to Finite Element Software	
14	27	Introduction to Finite Element Software	
	28	Introduction to Finite Element Software	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C2, C4
Final Exam	60%	CO 1	C2
		CO 2	C4
		CO 3	C4
Total Marks	100%		

REFERENCE BOOKS

1. Bathe, K.J., “Finite Element Procedures”, 1996.
2. Zienkiewicz, O.C. and Morgan, K., “Finite Elements and Approximation”, John Wiley and Sons, 1983.
3. Cook, R.D., “Finite Element Modelling for Stress Analysis”, John Wiley and Sons, 1995.
4. D.L. Logan, “A First Course in the Finite Element Method”, Third Edition, Thomson Learning, 2001, TA347.F5L 64.
5. J.N. Reddy, “An Introduction to the Finite Element Method”, Second Edition, McGraw-Hill International Editions, Singapore.
6. Grandin, H., “Fundamentals of the Finite Element Method”, Macmillan Publishing Company, 1986.
7. Weaver, W. And Johnston, P.R., “Finite Elements for Structural Analysis”, Prentice-Hall, 1984.
8. Beer, G. And Watson, J.O., “Introduction to Finite and Boundary Element Methods for Engineers”, John Wiley and Sons, 1992.

Fall Semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION

Course Code	: CE 421	Lecture contact hours	: 2.00
Course Title	: Dynamics of Structures	Credit hours	: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Structural dynamics is a basic course in defining and understanding dynamic problems mainly related to civil engineering. The course is intended to provide necessary knowledge to establish the equations of motion and for the determination of structural response from dynamic loads and experience in the modeling and calculation of dynamic response for simple structural systems. The knowledge gained through this course will be useful later on in various projects.

OBJECTIVE

- Learn how to model single-degree and vibratory systems and calculate the free and forced response of these systems.
- Ability to apply the structural dynamics theory to real world problems like seismic analysis and design of structures.

COURSE CONTENT

Single degree of freedom system, free vibration response; response to harmonic, impulse and general dynamic loading; numerical evaluation of dynamic response; earthquake response of linear system; two degrees of freedom system; response spectrum analysis.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **demonstrate** the dynamic behaviour of structural systems		√										
2	Ability to **find** response of structural systems under dynamic load		√										
3	Ability to **devise** mathematical model for solving field problems			√									

Program Outcomes (PO):							
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning							
COURSE OUTCOMES AND GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **demonstrate** the dynamic behaviour of structural systems	2	C3	1,2		2	Class Test, Mid Term, Final and class participation
CO2	Ability to **find** response of structural systems under dynamic load	2	C4	1,2		2, 3	Class Test, Mid Term, Final and class participation
CO3	Ability to **devise** mathematical model	3	C6	1,3		4	Class Test, Mid Term, Final and class participation

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks	28

Guided Learning Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning Individual learning (1 hour lecture ≈ 1 hour learning) Preparation for tests and examination	24 13
Assessment Pop Quiz/Class Test/Mid-Term Exam Final examination	03 02
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Topics	Assessments
1	Dynamics of single-degree-of-freedom systems	Pop Quiz/Class Test/Mid-Term Exam
2	Equations of Motion, Problems and Solutions	
3	Undamped Free Vibration, Viscously Damped Free Vibration	
4	Energy in Free Vibration	
5	Response to Harmonic and Periodic Excitations	
6	Systems with Nonviscous Damping, Response to Periodic Excitation	
7	Response to Arbitrarily Time-Varying Forces, Response to Step and Ramp Forces	
8	Response to Pulse Excitations	
9	Earthquake Excitation and Motion, Response Spectrum Analysis	
10	Systems with Distributed Mass and Elasticity	
11	Natural Vibration Frequency by Rayleigh's Method	
12	One-Story Unsymmetric-Plan Buildings,	
13	Multistory Unsymmetric-Plan Buildings	
14	Free Vibration Response for Multi-Degree-of-Freedom Systems	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous assessment	40%	CO1, CO2, CO3	C3, C4, C6
Final examination	60%	CO 1	C3
		CO 2	C4
		CO 3	C6
Total Marks	100%		

REFERENCE BOOKS

1. Dynamics of Structures - Theory and Applications to Earthquake Engineering, 5th Edition by Anil K. Chopra, Pearson Prentice Hall, 2016
2. Dynamics of Structures - R.W. Clough and J. Penzien, 2nd Edition

Fall Semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 423 : Structural Safety	Lecture contact hours Credit hours	: 2.00 : 2.00

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
The method for safety evaluation and risk assessment of civil structures will be studied. Definition of loadings and structural safety will be given in a probabilistic framework. Risk assessment of civil structures in earthquake regions will be analyzed with details. The knowledge gained through this course will be useful later on in various projects.

OBJECTIVE

- The student will gain a basic understanding of and a general awareness on safety aspects in structural and civil engineering, and will be able to judge whether it is necessary to account for uncertainties in engineering problems.
- When simplified deterministic procedures are applied, the student can critically reflect the implications of the simplifications.
- With basic understanding the student will be able to ask the right questions also for more advanced problems and might consult experts for their solution.

COURSE CONTENT
Structural Safety is a course to integrate risk assessment for a wide range of constructed facilities such as buildings, bridges, earth structures, offshore facilities, dams, lifelines and nuclear structural systems, especially RCC and steel structures. Its purpose is to gain in-depth knowledge about risk and reliability among technical disciplines involved in design and construction, and to enhance the use of risk management in the constructed environment. All aspects of quantitative safety assessment and to addresses the protection of structures and infrastructure such as buildings and bridges both RCC and Steel structures exposed to multiple hazards, including earthquakes, cyclones, fire hazards, hurricane, surge or corrosion.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Formulate** simple probabilistic models that represent relevant engineering phenomena		√										

2	**Define** adverse events (like failure or malfunction) in terms of limit states and assess the probability of these adverse events				√								
3	**Perform** the reliability based calibration of structural codes			√									

<u>Program Outcomes (PO)</u>:
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Formulate** simple probabilistic models that represent relevant engineering phenomena	2	C3, C4	1,2		2, 3	Class Test, Mid Term, Final and class participation
CO2	**Define** adverse events (like failure or malfunction) in terms of limit states and assess the probability of these adverse events	4	C2, C3	1,3		4	Class Test, Mid Term, Final and class participation
CO3	**Perform** the reliability based calibration of structural codes	3	C4, C5	1,5		5	Class Test, Mid Term, Final and class participation

<u>Knowledge Profile (K)</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

<u>Complex Engineering Problem (P)</u>:

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks	 28
Guided Learning Tutorial/ Assignments (2 hours/week x 5 weeks)	 10
Independent Learning Individual learning (1 hour lecture ≈ 1 hour learning) Preparation for tests and examination	 24 13
Assessment Pop Quiz/Class Test/Mid-Term Exam Final examination	 03 02
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE		
Week	**Topics**	**Assessments**
1	Review of conceptual design	Pop Quiz/Class Test/Mid-Term Exam
2	Review of probability theory	
3	Structural Component reliability analysis	
4	Analysis of uncertainties - Bayesian Reliability analysis	
5	Structural Systems Reliability analysis	
6	Simulation methods	
7	Probabilistic codified Design	
8	Examples of "Robust" structural design	
9	Examples of structural failures	
10	The role of conceptual design in structural reliability	
11	System Reliability	
12	Structural Code Concepts, Code Calibration	
13	Re-evaluation of the safety of existing structures	
14	Aspects of quality control	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous assessment	40%	CO1, CO2, CO3	C2, C3, C4, C5
Final examination	60%	CO 1	C3, C4
		CO 2	C2, C3
		CO 3	C4, C5
Total Marks	100%		

REFERENCE BOOKS

1. AISC Seismic Provisions for Structural Steel Buildings, ANSI/AISC 341-10
2. Structural Seismic Design Optimization and Earthquake Engineering: Formulation and Applications by Vagelis Plevris, Chara Ch. Mitropoulou, Nikos D Lagaros, 2012
3. Computational Methods in Earthquake Engineering by Papadrakakis, Fragiadakis and Lagaros, 2011
4. Journal of Structural Safety by Elsevier (for case studies)

Fall Semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 427 : Advanced Solid Mechanics	Lecture contact hours Credit hours	: 2.00 : 2.00

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
This course will teach the students to solve problems in solid mechanics which cannot be satisfactorily addressed by the approaches of mechanics of materials. The focus is on analytical methods and introductions to numerical methods are also covered. The knowledge gained through this course will be useful later on in various projects.

OBJECTIVE
• To expand on the basic principles established previously in Solid Mechanics. • To consolidate the solid mechanics principles presented in the student's Engineering degree, and the equip students with skills required to solve a range of engineering problems they have not seen before.

COURSE CONTENT
Stress, strain and displacements in two and three dimensions. Constitutive equations. Governing equations of elasticity and simple solutions, Formulation of basic equations of elasticity in solid mechanics, Strain energy. Theories of failure.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Solve** problems in elasticity using fundamental equations	√											
2	**Evaluate** the principal stress and principal strain for a given state of stress or strain		√										
3	**Formulate** the usage of energy methods for solving structural problems			√									

Program Outcomes (PO): **PO1**: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Solve** problems in elasticity using fundamental equations	1	C2,C3	1, 2		2	Class Test, Mid Term, Final and class participation
CO2	**Evaluate** the principal stress and principal strain for a given state of stress or strain	2	C5	1,2		2	Class Test, Mid Term, Final and class participation
CO3	**Formulate** the usage of energy methods for solving structural problems	3	C2,C3	1,3		3	Class Test, Mid Term, Final and class participation

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture	

(2 hours/week x 14 weeks	28
Guided Learning Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning Individual learning (1 hour lecture ≈ 1 hour learning) Preparation for tests and examination	24 13
Assessment Pop Quiz/Class Test/Mid-Term Exam Final examination	03 02
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Topics	Assessments
1	Introduction to stress analysis in elastic solid	Pop Quiz/Class Test/Mid-Term Exam
2	Hydrostatic and deviatoric stress components, octahedral shear stress	
3	Analogy between stress and strain tensors	
4	Constitutive equations – generalized Hooke"s law	
5	Equations for linear elastic isotropic solids	
6	Boundary conditions – St. Venant"s principle for end effects Uniqueness theorem	
7	Plane stress and plane strain problems	
8	Stress compatibility equation - Plane Stress	
9	Stress compatibility equation - Plane Strain	
10	Equilibrium equations, strain-displacement relations	
11	Axisymmetric problems	
12	Strain tensor	
13	Compatibility conditions	
14	Relation among elastic constants	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous assessment	40%	CO1, CO2, CO3	C2, C3, C5
Final examination	60%	CO 1	C2, C3
		CO 2	C5
		CO 3	C2, C3
Total Marks	100%		

REFERENCE BOOKS

1. Introduction to Solid Mechanics and Finite Element Analysis by Samer Adeeb
2. Advanced Strength and Applied Elasticity, 5th Edition, by A C Ugural and S K Fenster
3. The geometrical Language of Continuum Mechanics by Marcelo Epstein

7.2 Geotechnical Engineering

Spring Semester L-3, T-I

Theoretical (Core)

COURSE INFORMATION			
Course Code Course Title	: CE 341 : Principles of Soil Mechanics	Lecture Contact Hours Credit Hours	: 4.00 : 4.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course will enable the students to learn soil mechanics aspect of geotechnical engineering with an aim to acquire the basic knowledge of the geotechnical parameters needed for the purpose of designing foundations/ substructures of any civil engineering infrastructure, earth retaining and earth structures or any other structures resting on the surface and within the ground.			
OBJECTIVE			
On studying this course student will be able to: • **Understand** the geological processes for the formation of various types of soils, their physical and index properties, and their use in engineering and other classifications of soils that to be used in estimating the preliminary parameters in geotechnical designs. • **Understand** the principles of total, effective and neutral stresses in watery environment and distribution of stresses within soil mass due to external loading in order to predict the mechanical behavior (load deformation interaction) of foundation soils. • **Understand and determine** the mechanical properties including shear strength and compressibility characteristics of soil that to be used in any geotechnical designs of structures. • **Understand** the concepts of permeability of soil, its determination methods, the flowing phenomenon of water through soil, induced uplift pressure and seepage within the soil mass. • **Understand and compute** the lateral stresses induced due to deformation of soil and acting on the retaining structures and foundations.			
COURSE CONTENT			
Geotechnical Engineering and Soil Mechanics - Background; Formation, Type and Identification of Soils; Soil Structure and Fabric; Index Properties of Soil; Classifications of Soil; Weight-Volume Relationships; Soil Compaction; Total and Effective Stresses within Soil Mass due to Overburden; Stresses within the Soil Mass due to External Loading; Permeability and Seepage; Stress-Strain-Strength Characteristics of Soil; Compressibility and Settlement of Soil; Lateral Earth Pressure.			

COURSE OUTCOMES AND SKILL MAPPING

No.	**COURSE OUTCOMES (COs)**	**PROGRAMME OUTCOMES (POs)**											
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**

1	To acquaint with the attributes of geotechnical engineering especially soil mechanics and to acquire knowledge of soil the formation, physical and index properties of soil including weight volume relations, grain size analysis and consistency limits for the purpose of engineering classification of soils.	√											
2	To acquire the knowledge and to evaluate the engineering properties of soil including shear strength, compressibility, various stresses induced within the soil mass, and permeability of soil.		√										
3	To understand and assess the compaction aspect of shallow depth ground improvement, and lateral earth pressure within the soil mass due to overburden and surcharge loading.		√										

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	To acquaint with the attributes of geotechnical engineering especially soil mechanics and to acquire knowledge of soil the formation, physical and index properties of soil	1	C1	1	-	1	Class Test, Mid-term Exam, Pop Quiz, Final Exam.

	including weight volume relations, grain size analysis and consistency limits for the purpose of engineering classification of soils.						
CO2	To acquire the knowledge and to determine the engineering properties of soil including shear strength, compressibility, various stresses induced within the soil mass, and permeability of soil.	2	C3	1	-	3	Class Test, Mid-term Exam, Pop Quiz, Final Exam.
CO3	To understand and appraise the compaction phenomenon, and lateral earth pressure within the soil mass due to overburden and surcharge loading.	2	C1	1	-	3	Class Test, Mid-term Exam, Pop Quiz, Final Exam.

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (Hours)
Face to Face Learning Lecture (4 hours/week × 14 weeks)	56
Guided Learning Tutorial/ Assignments (4 hours/week × 5 weeks)	20
Independent Learning Individual Learning (1-hour Lecture ≈ 1-hour Learning) Preparation for Tests and Examination	48 30
Assessment	

Continuous Assessment Final Examination	3 3
Total	160

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING/ LECTURE SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Background of Geotechnical Engineering and Soil Mechanics*	
	2	Background of Geotechnical Engineering and Soil Mechanics*	
	3	Weight-Volume Relationships**	
	4	Total and Effective Stresses within Soil Mass due to Overburden***	
2	5	Formation, Type and Identification of Soils*	CT/ Assignment-1
	6	Formation, type and identification of soils*	
	7	Weight-Volume Relationships**	
	8	Total and Effective Stresses within Soil Mass due to Overburden***	
3	9	Soil Structure and Fabric*	
	10	Index Properties of Soil*	
	11	Weight-Volume Relationships**	
	12	Total and Effective Stresses within Soil Mass due to Overburden***	
4	13	Index properties of soil*	
	14	Index properties of soil*	
	15	Weight-Volume Relationships**	
	16	Total and Effective Stresses within Soil Mass due to Overburden***	
5	17	Index properties of soil*	CT/Assignment-2
	18	Classifications of Soil*	
	19	Soil Compaction**	
	20	Stresses within the Soil Mass due to External Loading***	
6	21	Classifications of Soil*	
	22	Classifications of Soil*	
	23	Soil Compaction**	
	24	Stresses within the Soil Mass due to External Loading***	
7	25	Classifications of Soil*	
	26	Stress-Strain-Strength Characteristics of Soil*	
	27	Soil Compaction**	

	28	Stresses within the Soil Mass due to External Loading***	
8	29	Stress-Strain-Strength Characteristics of Soil*	Mid Term/Assignment-3
	30	Stress-Strain-Strength Characteristics of Soil*	
	31	Soil Compaction**	
	32	Stresses within the soil mass due to external Loading***	
9	33	Stress-Strain-Strength Characteristics of Soil*	
	34	Stress-Strain-Strength Characteristics of Soil*	
	35	Permeability and Seepage**	
	36	Compressibility and Settlement of Soil***	
10	37	Stress-Strain-Strength Characteristics of Soil*	CT/Assignment-4
	38	Stress-Strain-Strength Characteristics of Soil*	
	39	Permeability and Seepage**	
	40	Compressibility and Settlement of Soil***	
11	41	Lateral Earth Pressure*	
	42	Lateral Earth Pressure*	
	43	Permeability and Seepage**	
	44	Compressibility and Settlement of Soil***	
12	45	Lateral Earth Pressure*	
	46	Lateral Earth Pressure*	
	47	Permeability and Seepage**	
	48	Compressibility and Settlement of Soil***	
13	49	Lateral Earth Pressure*	CT/Assignment-5
	50	Lateral Earth Pressure*	
	51	Permeability and Seepage**	
	52	Compressibility and Settlement of Soil***	
14	53	Lateral Earth Pressure*	
	54	Lateral Earth Pressure*	
	55	Permeability and Seepage**	
	56	Compressibility and Settlement of Soil***	

*Course Instructor 1, ** Course Instructor 2, *** Course Instructor 3

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class Assignments/ CT/ Mid Term/ Class Participation)	40%	CO1, CO2, CO3,	C1, C3
Final Exam	60%	CO1	C1

		CO2 CO3	C3 C1
Total Marks	100%		

REFERENCE BOOKS/ MATERIALS

1. Foundation Engineering – R. B. Peck, W. E. Hanson and T. H. Thornburn.
2. Principles of Geotechnical Engineering – B. M. Das and K. Sobhan.
3. Geotechnical Engineering Soil Mechanics – J. N. Cernica.
4. An Introduction to Geotechnical Engineering – R. D. Holtz, W. D. Kovacs and T. C. Sheahan.
5. Geotechnical Engineering Principles and Practices – D. P. Coduto.
6. Course Handouts and Class Lectures.

Spring Semester L-3, T-I

Sessional (Core)

COURSE INFORMATION			
Course Code Course Title	: CE 342 : Geotechnical Engineering Sessional	Lecture Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course will enable the students to perform various hands-on laboratory and field tests, analyze the data and prepare reports on various physical, index and engineering properties of soil.

OBJECTIVE

- To perform tests and to prepare reports on various physical and index properties tests like field identification, specific gravity of soil solids, grain size analysis, limits tests, and maximum and minimum dry densities.
- To perform tests and to prepare reports on various tests on engineering properties of soil like unconfined compressive strength, direct shear strength, consolidation behaviour and permeability of soil, and also laboratory and field tests on ground modification like field density and laboratory compaction tests.

COURSE CONTENT

Field Identification of Soil; Specific Gravity of Soil Particles; Grain Size Analyses of Soil by Sieve and Hydrometer; Atterberg's Limits; Laboratory Soil Compaction; Maximum and Minimum Densities of Sandy Soils; Field Density of Soil; Permeability of Soil by Constant Head and Falling Head; Unconfined Compression Test of Cohesive Soil; Direct Shear Test of Soil; Consolidation Test.

COURSE OUTCOMES AND SKILL MAPPING

No.	**COURSE OUTCOMES (COs)**	**PROGRAMME OUTCOMES (POs)**											
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
1	Ability to **determine** various physical, index and engineering properties of soil using standard test procedures.	√											
2	Ability to **analyse** the data obtained from various field and		√										

	laboratory tests related to engineering soils.												

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **determine** various physical, index and engineering properties of soil using standard test procedures.	1	C3	1		3	Class Assessment, Lab Report, Mid Quiz, Final Quiz, Viva
CO2	Ability to **analyse** the data obtained from various field and laboratory tests related to engineering soils.	2	C4	3		4	Class Assessment, Lab Report, Mid Quiz, Final Quiz, Viva

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	**Engagement (Hours)**
Face to Face Learning	
Lecture (3 hours/week × 14 weeks)	33
Guided Learning	
Tutorial/ Assignments (3 hours/week × 5 weeks)	10
Independent Learning	
Individual learning (1-hour lecture ≈ 1-hour learning)	8
Preparation for tests and examination	4
Assessment	
Continuous Assessment	2
Final examination	3
Total	60

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning.

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Field identification tests	Lab Report, Class Assessment, Mid Quiz
2	2	Specific gravity test of soil particles	
3	3	Grain size analysis by sieve and hydrometer	
4	4	Atterberg limits test	
5	5	Compaction test	
6	6	Maximum and minimum densities test of sandy soil	
7	7	Mid Quiz	
8	8	Permeability tests	Lab Report, Class Assessment, Final Quiz
9	9	Unconfined compression test	
10	10	Direct shear tests	
11	11	Consolidation tests	
12	12	Consolidation tests	

13	13	Final Quiz	
14	14	Viva	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment	40%	CO1, CO2	C3, C4
Quiz	60%	CO 1	C3
		CO 2	C4
Total Marks	100%		

REFERENCE BOOKS

1. Soil Testing for Engineers – T. W. Lambe
2. Engineering Properties of Soils and Their Measurement – J. E. Bowles.
3. Soil Mechanics Laboratory Manual – B. M. Das.
4. Soil Mechanics Lab Manual – M. E. Kalinski.
5. Geotechnical Engineering Laboratory Handout: MIST

Fall Semester L-3, T-II

Theoretical (Core)

COURSE INFORMATION			
Course Code Course Title	: CE 343 : Foundation Engineering	Lecture Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
CE 341			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course will enable the students to acquire the skill of interpreting subsoil condition of a project site, determining bearing capacity and estimating settlement of shallow and deep foundations, and also analysing the stability of slopes of earthen structures.			
OBJECTIVE			
• To plan and design the subsoil investigation program of any project site for its characterization including soil profiling in order to design proper foundations of any civil engineering structures.. • To evaluate the bearing capacity and settlement for the purpose of designing shallow foundations including footings and raft for a structure on various subsoil and loading conditions. • To evaluate compressive, uplift and lateral bearing capacity and settlement of single and group pile foundations for a structure in various subsoil and loading conditions. • To analyze the performance of existing foundations. • To analyze and check the stability of any soil slopes in various soil and groundwater conditions.			
COURSE CONTENT			
Subsoil Investigations; Types of Shallow and Deep Foundations; Bearing Capacity Equations and Factors for Shallow Foundations; Settlement of Shallow Foundations; Compression, Uplift and Lateral Load Carrying Capacity of Pile Foundations; Settlement of Pile Foundations; Slope Stability.			

COURSE OUTCOMES AND SKILL MAPPING

No.	**COURSE OUTCOMES (COs)**	**PROGRAMME OUTCOMES (POs)**											
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
1	Ability to characterize the subsoil condition of a site in order to decide on the type of foundation of any structures suitable for the particular site.		√										

2	Ability to analyse and evaluate the bearing capacity and settlement for the purpose of designing shallow foundations including raft, and single and group pile foundations for a structure in various subsoil and loading conditions.		√										
3	Ability to analyse and check the stability of soil slopes in various slope, subsoil and groundwater conditions.		√										

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	CP (WP)	CA (EA)	KP (WK)	Assessment Methods
CO1	Ability to characterize the subsoil condition of a site in order to decide on the type of foundation of any structures suitable for the particular site.	2	C1	3		4	Pop Quiz, Class Test
CO2	Ability to analyse and evaluate the bearing capacity and settlement for the purpose of designing shallow foundations including raft, and single and group pile foundations for a structure in various subsoil and loading conditions.	2	C3	3		4	Class Test/ Mid-Term/ FinalExam
CO3	Ability to analyse and check the stability of soil slopes in various slope, subsoil and groundwater conditions.	2	C3	3		4	Final Exam

WP= Washington Accord Complex Problem Solving/ CP= Complex Problem Solving; EA= Engineering Activities/ CA= Complex Activities; WK= Washington Accord Knowledge Profile/ KP= Knowledge Profile

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	**Engagement (Hours)**
Face to Face Learning	
Lecture (3 hours/week × 14 weeks)	42
Guided Learning	
Tutorial/ Assignments (3 hours/week × 5 weeks)	15
Independent Learning	
Individual learning (1-hour lecture ≈ 1-hour learning)	36
Preparation for tests and examination	22
Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning.

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Scope and aspects of foundation engineering; Information required from a subsoil investigation.*	CT/ Assignment-1
	2	Introduction to stability of slopes; Analysis of infinite slopes of cohesionless, cohesive and c-φ soils.**	
	3	Planning of subsoil investigation; Cost of exploration; Number and location of boring; Depth of boring.*	
2	4	Types of boring: Auger boring; Hollow stem auger boring; Wash boring; Percussion boring; ODEX drilling.*	
	5	Planner method of stability analysis of finite slopes; Culmann's analysis.**	
	6	Types of boring: Auger boring; Hollow stem auger boring; Wash boring; Percussion boring; ODEX drilling.*	
3	7	Determination of ground water table; Soil sample, Soil sampling and soil samplers.*	
	8	Effect of submergence and seepage on stability of infinite slopes.**	

	9	Penetration tests; Standard penetration test and SPT N-values; Corrections for SPT N-values; SPT and soil strength parameters.*	
4	10	Penetration tests; Standard penetration test and SPT N-values; Corrections for SPT N-values; SPT and soil strength parameters.*	CT/ Assignment-2
	11	Different modes of circular finite slope failure; Mass method of stability of slopes.**	
	12	Types of soil samplers; Types of soil samples and their usages; Sample disturbance and its measurement; Rock quality designation.*	
5	13	Dynamic cone penetration test; Dutch cone penetration (CPT); Cone and sleeve resistance.*	
	14	Slices methods of stability of slopes; Ordinary method of slices.**	
	15	CPT friction ratio and its relationship with soil types; Use of piezocone in determining porewater pressure and water table; CPT-SPT relations.*	
6	16	Geophysical methods of subsoil investigation; Field vane shear test; Subsoil investigation report.*	
	17	Simplified Bishop method of stability analysis.**	
	18	Types of shallow foundation; Failure mechanism of foundation soil under footing.*	
7	19	General bearing capacity equations for shallow foundation.*	
	20	Taylor's chart in analyzing stability of slopes. Various methods of determining centre or locus of slip surface.**	
	21	Bearing capacity factors and angle of internal friction of soil; Bearing capacity factors proposed by various authorities.*	
8	22	Types of deep foundation; Classification and use of pile foundation.**	Mid Term/ Assignment-3
	23	Bearing capacity of strip footing on cohesionless soil; Effect of footing shapes on bearing capacity.*	
	24	Driven and bored piles; Friction and bearing piles; Analysis of skin friction and end bearing for driven piles in sand.**	
9	25	Computation of skin friction of driven piles in clay; α-method.**	

	26	Bearing capacity of strip footing on cohesionless soil; Effect of footing shapes on bearing capacity; Design charts for the design of footing on cohesionless soil.*	
	27	Critical depth concept for piles in cohesionless soil; Estimation of skin friction and end bearing using critical depth concept.**	
10	28	Computation of skin friction of driven piles in clay; β-method; λ-method.**	
	29	Bearing capacity of footing on clay; Skempton equation.*	
	30	End bearing for piles in clay soil; Bearing capacity of group piles in sand and clay; Efficiency of pile group.**	
11	31	Effect of load eccentricity on group piles; Estimation of bearing capacity from SPT-value for piles in sand, clay and silty soil.**	
	32	Bearing capacity of footing on clay; Skempton's equation.*	
	33	Negative skin friction and remedial measures. Bearing capacity of bored piles.**	
12	34	Pile driving formula; Uplift capacity of individual pile and group.**	CT/ Assignment-4
	35	Load eccentricity on bearing capacity; Meyerhof concept of equivalent footing width. *	
	36	Laterally loaded piles.**	
13	37	Laterally loaded piles.**	
	38	Bearing capacity of raft foundation; Factor of safety in bearing capacity. Construction problems of footing and raft foundation.*	
	39	Pile load test and interpretation of load test data.**	
14	40	Construction problems of driven piles and bored piles. Concreting of bored piles; Reverse circulation method.**	
	41	Computation of settlement of footing; Elastic settlement; immediate settlement and consolidation settlement.*	
	42	Construction problems of driven piles and bored piles; Concreting of bored piles; Reverse circulation method.**	
* Course Instructor 1, **Course Instructor 2			

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C1, C3
Final Exam	60%	CO 1 CO 2 CO 3	C1 C3 C3
Total Marks	100%		

REFERENCE BOOKS

1. Foundation Engineering – R. B. Peck, W. E. Hanson and T. H. Thornburn.
2. Foundation Analysis and Design – J. E. Bowles.
3. Shallow Foundations Discussions and Problem Solving – T. M. Baban.
4. Pile Foundations in Engineering Practice – S. Prakash and H. D. Sharma.
5. Principles of Foundation Engineering – B. M. Das and N. Sivakugan.
6. Foundation Design Principles and Practices – D. P. Coduto, W. A. Kitch and M. R. Yeoung
7. Handouts and Lecture Notes on CE 441, MIST.

Fall Semester L-4, T- II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 443 : Earth Retaining Structures	Lecture Contact Hours Credit Hours	: 2.00 : 2.00

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
By studying this course, students will be familiarized with various types of earth retaining structures and their usages. They will also be able to analyze and design different types of earth retaining structures, braced excavation, dewatering system for deep excavation, caisson foundation and cofferdams.

OBJECTIVE

- To be able to familiarize with the foundations subjected to lateral loads and various types of earth retaining structures, and their usages**.**
- To be able to analyse and design rigid and flexible earth retaining structures, braced excavation, dewatering system, slurry wall, cofferdam and caissons**.**
- To be able to identify construction problems in excavations and earth retaining structures.

COURSE CONTENT
Foundation of Structures Subjected to Lateral Loads; Earth Retaining Structures; Gravity and Cantilever Retaining Walls; Deep Excavations: Sheet Pile Walls, RC Pile Walls, Slurry Walls and Ground Freezing; Braced Excavation, Construction Dewatering; Caissons and Cofferdams, Construction Problems in Excavation and Earth Retaining Structures.

COURSE OUTCOMES AND SKILL MAPPING

No.	**COURSE OUTCOMES (COs)**	**PROGRAMME OUTCOMES (POs)**											
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
1	To be able to familiarize with the foundations subjected to lateral loads and various types of earth retaining structures, and their usages.	√											

2	To be able to analyse and design rigid and flexible earth retaining structures, bracing systems, dewatering system, slurry wall, cofferdam and caissons.		√										
3	To be able to identify construction problems in excavations and earth retaining structures		√										

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	To be able to familiarize with the foundations subjected to lateral loads and various types of earth retaining structures, and their usages.	1	C1	1		1	Class Test, Mid-term, Pop quiz, Final Exam
CO2	To be able to analyse and design rigid and flexible earth retaining structures, bracing systems, dewatering system, slurry wall, cofferdam and caissons.	2	C4	3		3	Class Test, Mid-term, Pop quiz, Final Exam
CO3	To be able to identify construction problems in excavations and earth retaining structures	2	C1	1		3	Class Test, Mid-term, Pop quiz, Final Exam

<u>Knowledge Profile (K)</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

<u>Complex Engineering Problem (P)</u>:

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

<u>Complex Engineering Activities (A)</u>:

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

<u>Bloom's Taxonomy Levels</u>:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (Hours)
Face to Face Learning	
Lecture (2 hours/week × 14 weeks)	28
Guided Learning	
Tutorial/ Assignments (3 hours/week × 5 weeks)	15
Independent Learning	
Individual Learning (1-hour lecture ≈ 1-hour learning)	18
Preparation for Tests and Examination	14
Assessment	
Continuous Assessment	2
Final Examination	3
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Lateral Earth Pressure and Retaining Structures	CT/ Assignment-1
	2	Rigid Earth Retaining Structures	
2	3	Rigid Earth Retaining Structures	
	4	Rigid Earth Retaining Structures	
3	5	Cantilever Sheet Pile Walls	CT/ Assignment-2

	6	Cantilever Sheet Pile Walls	
4	7	Cantilever Sheet Pile Walls	
	8	Anchored Sheet Pile Walls	
5	9	Anchored Sheet Pile Walls	
	10	Braced Excavation	Mid Term/ Assignment-3
6	11	Braced Excavation	
	12	Braced Excavation	
7	13	Pile Retaining Walls	
	14	Pile Retaining Walls	
8	15	Slurry Walls	
	16	Slurry Walls	
9	17	Ground Freezing	
	18	Ground Freezing	
10	19	Deep Excavation and Dewatering	
	20	Deep Excavation and Dewatering	
11	21	Deep Excavation and Dewatering	
	22	Caissons Foundations	CT/ Assignment-4
12	23	Caissons Foundations	
	24	Caissons Foundations	
13	25	Cofferdams	
	26	Cofferdams	
14	27	Construction Problems in Excavation and Earth Retaining Structures.	
	28	Construction Problems in Excavation and Earth Retaining Structures.	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Bloom's Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Class Participation)	40%	CO1, CO2, CO3	C1, C4, C1
Final Exam	60%	CO1 CO2 CO3	C1 C4 C1
Total Marks	100%		

REFERENCE BOOKS
1. Earth Pressure and Earth Retaining Structures – C. R.I. Clayton, R. I. Woods, A. J. Bond and J. Milititsky. 2. Soil Mechanics and Foundation Engineering – N. Rao. 3. Principles and Practices of Ground Improvement – Jie Han. 4. Construction Dewatering and Groundwater Control – J. P. Powers, A. B. Corwin, P. C. Schmall and W. E. Kaeck. 5. Principles of Foundation Engineering by B. M. Das and N. Sivakugan. 6. Advanced Foundation Engineering – V. N. S. Murthy.

Fall Semester L-4, T- II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 447 : Soil-water Interaction	Lecture contact Hours Credit Hours	: 2.00 : 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course will help students to understand the soil properties for the design of foundation, especially to learn how to understand permeability and seepage behavior of soil, capillary action, soil suction for proper design. Students will also be introduced with the concept of slope stability subjected to wave current, design geotechnical landfill for slope stability which will be very useful in their professional life.

OBJECTIVE

- To comprehend the concept of ppermeability for homogeneous and stratified soil including one dimensional flow in layered Soil.
- To analyse seepage, capillary, soil suction and slopes subjected to steady seepage.
- To analyze flow through earth dams.
- To design filters and revetments.

COURSE CONTENT

Water in Soil: Occurrence and Effects; Soil Water Interaction Problems; Vertical and Horizontal Permeability for Homogeneous and Stratified Soils; Seepage, Capillary and Soil Suction; One Dimensional Flow in Layered Soil; Flow through Earth Dams; Slopes Subjected to Seepage, Water Current and Wave Action; Filters and Revetments.

COURSE OUTCOMES AND SKILL MAPPING

No.	**COURSE OUTCOMES (COs)**	**PROGRAMME OUTCOMES (POs)**											
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
1	To be able to comprehend the concept of permeability for homogeneous and stratified soil including one Dimensional Flow in Layered Soil	√											

2	To be able to **analyse** seepage, capillary, soil suction and slopes subjected to steady seepage		√										
3	To be able to **analyse** flow through earth dams.		√										
4	To be able to design filters and revetments.			√									

<u>Program Outcomes (PO)</u>:
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	**Course Outcomes**	**Corresponding POs**	**Bloom's Taxonomy**	**P**	**A**	**K**	**Assessment Methods**
CO1	To be able to comprehend the concept of permeability for homogeneous and stratified soil including one Dimensional Flow in Layered Soil	1	C2	1		3	Class Test, Mid-term, Pop quiz, Final Exam
CO2	To be able to **analyse** seepage, capillary, soil suction and slopes subjected to steady seepage	2	C4	2		4	Class Test, Mid-term, Pop quiz, Final Exam
CO3	To be able to **analyse** flow through earth dams.	2	C4	2		4	Assignment, Pop quiz
CO4	To be able to design filters and revetments.	3	C5	2		5	Assignment, Pop quiz

<u>Knowledge Profile (K)</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):
P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence
Complex Engineering Activities (A):
A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity
Bloom's Taxonomy Levels:
C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (Hours)
Face to Face Learning	
Lecture (2 hours/week × 14 weeks)	28
Guided Learning	
Tutorial/ Assignments (2 hours/week × 5 weeks)	10
Independent Learning	
Individual learning (1-hour lecture ≈ 1-hour learning)	24
Preparation for tests and examination	13
Assessment	
Continuous Assessment	2
Final examination	3
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning.

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Water in soil: occurrence and effects	CT/ Assignment-1
	2	Water in soil: occurrence and effects	
2	3	Soil- water Interaction problems	
	4	Soil- water Interaction problems	
3	5	Vertical and horizontal permeability for homogeneous and stratified soils	
	6	Vertical and horizontal permeability for homogeneous and stratified soils	
4	7	Vertical and horizontal permeability for homogeneous and stratified soils	Mid Term/ Assignment-2

	8	Seepage, capillary and soil suction	
5	9	Seepage, capillary and soil suction	
	10	Seepage, capillary and soil suction	
6	11	One dimensional flow in layered soil	
	12	One dimensional flow in layered soil	
7	13	One dimensional flow in layered soil	
	14	Flow through earth dams	
8	15	Flow through earth dams	
	16	Flow through earth dams	
9	17	Slopes subjected to seepage	
	18	Slopes subjected to seepage	
10	19	Slopes subjected to seepage	
	20	Slopes subjected to seepage	
11	21	Water current and wave action	CT/ Assignment-3
	22	Water Current and Wave Action	
12	23	Water Current and Wave Action	
	24	Water current and wave action	
13	25	Filters and revetments	
	26	Filters and revetments	
14	27	Filters and revetments	
	28	Filters and revetments	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Bloom's Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3, CO4	C2, C4, C5
Final Exam	60%	CO 1	C2
		CO 2	C4
		CO 3	C4
		CO4	C5
Total Marks	100%		

REFERENCE BOOKS
1. Seepage, Drainage, and Flow Nets – H. R. Cedergren. 2. Ground Water Hydrology – D. K. Todd and L.W. Mays. 3. Basic Ground Water Hydrology – R. C. Heath. 4. Soil Water Interactions Mechanisms and Applications – S. Iwata, T. Tabuchi and B. P. Warkentin. 5. Earth and Earth-Rock Dams: Engineering Problems of Design and Construction –J. L. Sherard. 6. Advanced Soil Mechanics – B. M. Das. 7. Soil Mechanics and Foundations – J. V. Parcher and R. E. Means. 8. BWDB Design Manual.

Fall Semester L-4, T- II

Theoretical (Elective)

COURSE INFORMATION

Course Code	: CE 445	Lecture Contact Hours	: 2.00
Course Title	: Elementary Soil Dynamics	Credit Hours	: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Un this course, the students will learn about dynamic properties of soil, seismic response of soil, soil liquefactions and other which will be useful in various projects in the later semesters and in their professional life.

OBJECTIVE

- To comprehend the fundamental knowledge on vibration theory for different free and forced vibration system
- To apply the knowledge of site amplification for assimilating the wave propagation effect
- To be able to analyse and design machine foundation systems for different characterizing factors

COURSE CONTENT

Elementary Vibrations; Dynamic Properties of Soil; Seismic Response of Soil; Seismic Site Characterization and Site Amplification; Soil Liquefaction; Earthquake Hazards and Remedial Measures, Dynamic Bearing Capacity Analyses, Machine Foundations.

COURSE OUTCOMES AND SKILL MAPPING

No	**COURSE OUTCOMES (COs)**	**PROGRAMME OUTCOMES (POs)**											
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
1	Ability to **comprehend** the fundamental knowledge on vibration theory for different free and forced vibration system .	√											
2	Ability to **analyse and design** machine foundation system for different characterizing factors.		√										

3.	Ability to **investigate** the seismic response of soil and estimate the liquefaction potential of a project site.		√										

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **comprehend** the fundamental knowledge on vibration theory for different free and forced vibration system.	1	C2	1		3	Class Test, Mid-term, Pop quiz, Final Exam
CO2	Ability to **analyse and design** machine foundation system for different characterizing factors.	2	C4	3		4	Class Test, Mid-term, Pop quiz, Final Exam
CO3	Ability to **investigate** the seismic response of soil and estimate the liquefaction potential of a project site.	2	C3	2		4	Class Test, Mid-term, Pop quiz, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom’s Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	**Engagement (hours)**
Face to Face Learning	
Lecture (2 hours/week × 14 weeks)	28
Guided Learning	
Tutorial/ Assignments (3 hours/week × 5 weeks)	15
Independent Learning	
Individual learning (1-hour lecture ≈ 1-hour learning)	20
Preparation for tests and examination	12
Assessment	
Continuous Assessment	2
Final examination	3
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning.

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Dynamic Properties of Soil	CT/ Assignment-1
	2	Dynamic Properties of Soil	
2	3	Dynamic Properties of Soil	
	4	Dynamic Properties of Soil	
3	5	Elementary Vibrations	
	6	Elementary Vibrations;	
4	7	Seismic Response of Soil	CT/ Assignment-2
	8	Seismic Response of Soil	
5	9	Seismic Site Characterization and Site Amplification	
	10	Seismic Site Characterization and Site Amplification	
6	11	Dynamic Bearing Capacity Analyses	Mid Term/ Assignment-3
	12	Dynamic Bearing Capacity Analyses	
7	13	Dynamic Bearing Capacity Analyses	
	14	Dynamic Bearing Capacity Analyses	
8	15	Dynamic Bearing Capacity Analyses	

	16	Dynamic Bearing Capacity Analyses	
9	17	Soil Liquefaction	
	18	Soil Liquefaction	
10	19	Soil Liquefaction	
	20	Soil Liquefaction	
11	21	Principles of Machine Foundations.	
	22	Principles of Machine Foundations.	
12	23	Principles of Machine Foundations.	CT/ Assignment-4
	24	Principles of Machine Foundations.	
13	25	Principles of Machine Foundations.	
	26	Principles of Machine Foundations.	
14	27	Earthquake Hazards and Remedial Measures	
	28	Earthquake Hazards and Remedial Measures	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C2, C3, C4
Final Exam	60%	CO 1 CO 2 CO 3	C2 C4 C3
Total Marks	100%		

REFERENCE BOOKS

1. Principles of Soil Dynamics – B. M. Das and G. V. Ramana.
2. Fundamentals of Soil Dynamics and Earthquake Engineering – B. B. Prasad.
3. Soil Dynamics – S. Prakash.
4. Soil Dynamics with Applications in Vibration and Earthquake Protection – C. Vrettos.

Fall Semester L-4, T- II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 449 : Numerical Methods in Geotechnics	Lecture Contact Hours Credit Hours	: 2.00 : 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course will help students to understand the concept of Tensor Analyses, Stresses, Strains. In this course, students will also be introduced with the different material models which will help the students to solve the problems by finite element method, an essential tool for the designers to design any geotechnical structure nowadays.

OBJECTIVE

- To **understand** Tensor Analyses, stresses, and strains
- To **identify** Failure and Palstic Flow, Dilatancy, Yielding and Hardening, preconsolidation of soil.
- To **understand** material models and **solve** geotechnical problems by finite element method

COURSE CONTENT

Introduction to Tensor Analyses: Stresses, Strains; Equations of Continuum Mechanics Isotropic Elasticity, Anisotropy, Stress Dependency, Nonlinearity, Failure and Plastic Flow, Dilatancy, Yielding and Hardening, Pre-consolidation, Material Models, Critical State, Rate Dependency, Finite Element and Finite Difference in Geotechnical Engineering.

COURSE OUTCOMES AND SKILL MAPPING

No	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **understand** tensor analyses, stresses, and strains	√											
2	Ability to **identify** failure and plastic flow, dilatancy, yielding and hardening, preconsolidation of soil	√											
3	Ability to **understand** material models and **solve** geotechnical					√							

	problems by finite element method												

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	**Course Outcomes**	**Corresponding POs**	**Bloom' s Taxonomy**	**P**	**A**	**K**	**Assessment Methods**
CO1	Ability to **understand** tensor analyses, stresses, and strains	1	C1	1		1	Class Test, Mid-term, Pop quiz, Final Exam
CO2	Ability to **identify** failure and plastic flow, dilatancy, yielding and hardening, preconsolidation of soil	1	C1	1		3	Class Test, Mid-term, Pop quiz, Final Exam
CO3	Ability to **understand** material models and **solve** geotechnical problems by finite element method	5	C2	3		4	Assignment, Pop quiz

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face to Face Learning	

Lecture (2 hours/week × 14 weeks)	28
Guided Learning Tutorial/ Assignments (2 hours/week × 5 weeks)	 10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 28 14
Assessment Continuous Assessment Final examination	 2 3
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Introduction to Tensor Analyses, Stresses, Strains	CT/ Assignment-1
	2	Introduction to Tensor Analyses, Stresses, Strains	
2	3	Introduction to Tensor Analyses, Stresses, Strains	
	4	Equation of Continuum Mechanics	
3	5	Equation of Continuum Mechanics	
	6	Isotropic Elasticity, Anisotropy	Mid Term/ Assignment-2
4	7	Isotropic Elasticity, Anisotropy	
	8	Isotropic Elasticity, Anisotropy	
5	9	Stress Dependency, Nonlinearity	
	10	Stress Dependency, Nonlinearity	
6	11	Stress Dependency, Nonlinearity	
	12	Failure and Plastic Flow, Dilatancy, Yielding and Hardening	
7	13	Failure and Plastic Flow, Dilatancy, Yielding and Hardening	
	14	Failure and Plastic Flow, Dilatancy, Yielding and Hardening	
8	15	Failure and Plastic Flow, Dilatancy, Yielding and Hardening	
	16	Preconsolidation	

9	17	Material Models	
	18	Material Models	
10	19	Material Models	
	20	Critical State	
11	21	Critical State	
	22	Rate Dependency	CT/ Assignment-3
12	23	Rate Dependency	
	24	Finite Elements, Finite Difference	
13	25	Finite Elements, Finite Difference	
	26	Finite Elements, Finite Difference	
14	27	Finite Elements, Finite Difference	
	28	Finite Elements, Finite Difference	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2,CO3	C1, C2
Final Exam	60%	CO 1 CO 2 CO 3	C1 C1 C2
Total Marks	100%		

REFERENCE BOOKS

1. Constitutive Modelling in Geomechanics - A Puzrin.
2. Numerical Methods in Geotechnical Engineering - Chandrakant S. Desai and J. T. Christian.
3. Applied Soil Mechanics with Abaqus Applications - S Halwany
4. Plasticity and Geotechnics - Hai Sui Yu
5. Soil Constitutive Models by Evaluation, Selection and Calibration - J A Yammuro and V N Kaliakin

Fall Semester L-4, T-II

Sessional (Elective)

COURSE INFORMATION

Course Code	: CE 442	Lecture Contact Hours	: 3.00
Course Title	: Foundation Design Sessional	Credit Hours	: 1.5

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course will help students to interpret Subsoil Investigation Report; Geotechnical and Structural Designs of Footing, Raft and Piles; Design of Braced Excavations; Plate and Pile Load Tests, and Testing of Geotextiles for Index and Strength Properties.

OBJECTIVE

- To **interpret** the subsoil investigation report in order to decide on the types any foundations.
- To **evaluate** the bearing capacity and settlement for the purpose of designing footing, raft, and pile foundations for a structure on various subsoil and loading conditions.
- To **analyse** and prepare reports on the performance of existing foundations like footing, raft, and pile foundation in various subsoil conditions
- To be able to **perform** index and strength tests on geotextiles

COURSE CONTENT

Interpretation of Subsoil Investigation Report; Geotechnical and Structural Designs of Footing, Raft and Piles; Design of Braced Excavations; Plate and Pile Load Tests, Index and Strength properties tests of geotextiles.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **explore** types of foundation based on subsoil investigation report.	√											
2	Ability to **evaluate** the bearing capacity and settlement for the purpose of designing footing, raft, and pile foundations for a structure on various		√										

	subsoil and loading conditions.												
3	Ability to **analyze** the performance of existing foundations in various subsoil conditions.		√										
4	Ability to **perform** index and strength properties testing of geotextiles.	√											

<u>Program Outcomes (PO)</u>:
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	**Course Outcomes**	**Corresponding POs**	**Bloom's Taxonomy**	**P**	**A**	**K**	**Assessment Methods**
CO1	Ability to **explore** types of foundation based on subsoil investigation report.	1	C1	1		1	Assignment, Quiz
CO2	Ability to **evaluate** the bearing capacity and settlement for the purpose of designing footing, raft, and pile foundations for a structure on various subsoil and loading conditions.	2	C5	3		3	Assignment, Quiz
CO3	Ability to **analyze** the performance of existing foundations in various subsoil conditions	2	C4	3		4	Assignment, Quiz
CO4	Ability to **perform** index and strength properties testing of geotextiles.	1	C1	1		1	Assignment, Quiz

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (Hours)
Face to Face Learning	
Lecture (3 hours/week × 14 weeks)	42
Guided Learning	
Assignments (3 hours/week × 5 weeks)	7
Independent Learning	
Individual learning (1-hour lecture ≈ 1-hour learning)	7
Assessment	
Continuous Assessment	3
Quiz	1
Total	60

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning.

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Interpretation of subsoil investigation report and estimation of bearing capacity of shallow foundations by hand calculation and spreadsheet.	Assignments and Quiz-1
2	2	Interpretation of subsoil investigation report and estimation of bearing capacity of shallow foundations by hand calculation and spreadsheet	
3	3	Structural design of isolated spread footing.	
4	4	Structural design of a combined footing.	

5	5	Bearing capacity and settlement calculation of raft foundation and its structural design.	
6	6	Bearing capacity and settlement calculation of raft foundation and its structural design.	
7	7	Manual calculations of bearing capacity for single and group piles based on actual subsoil investigation report,.	
8	8	Manual calculations of bearing capacity for single and group piles based on actual subsoil investigation report,.	
9	9	Plate load test and data analysis.	Assignments and Quiz-2
10	10	Pile load test and data analysis.	
11	11	Testing of geotextiles: index properties.	
12	12	Testing of geotextiles: strength and CBR	
13	13	Introduction to geotechnical software.	
14	14	Final Quiz and Viva.	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ Active Class Participation)	40%	CO1, CO2, CO3, CO4	C1, C5, C4, C1
Quiz	60%	CO1 CO2 CO3 CO4	C1 C5 C4 C1
Total Marks	100%		

REFERENCE BOOKS

1. Foundation Engineering - R. B. Peck, W. E. Hanson and T. H. Thornburn.
2. Foundation Analysis and Design - Joseph E. Bowles.
3. Principles of Foundation Engineering – B. M. Das and N. Sivakugan.
4. Geotechnical Engineering Foundation Design - J. N. Cernica.
5. Foundation Design Principles and Practices – D. P. Coduto, W. A. Kitch and M. R. Yeoung.
6. Soils in Construction - W. L. Schroeder, S. E. Dickenson and D. C. Warrington.

7.3 Transportation Engineering

Fall Semester L-3, T-II

Theoretical (Core)

COURSE INFORMATION			
Course Code Course Title	: CE 351 : Fundamentals of Transportation Engineering	Contact hours Credit hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
It’s an introductory course of transportation engineering. Students will be oriented with different types of transportation systems, modes, components of geometric design and traffic engineering. After this course students are expected to determine different geometric features of the highway, conduct volume & speed study, install traffic control device and identify components of transportation system.			
OBJECTIVE			
• To acquire knowledge on geometric design of highways • To comprehend highway capacity and level of service • To orient with the transportation system in Bangladesh • To orient with road traffic systems including fundamentals of traffic engineering • To understand basics of transport planning • To get acquainted with Intelligent Transportation System (ITS) and Traffic Impact Assessment (TIA)			
COURSE CONTENT			
Transportation engineering, transportation functions; transportation systems, functional components, factors in transportation development, transportation modes, public transportation, emerging modes; transport planning: concepts, scope and hierarchy, process, goals and objectives, inventories, socio-economic activities, land use-transport interaction, travel demand forecasting; transportation in Bangladesh: transportation modes and networks, constraints and challenges, transport demand and modal share, road classification and design standards. Geometric design of highways: design controls and criteria, cross sectional elements, alignment, sight distance, intersection and interchange layouts and design, planning and design of bicycle and pedestrian facilities; Terminal, highway capacity and level of service: Introduction to road safety issues. Traffic engineering: fundamentals of traffic engineering, vehicle and traffic characteristics, traffic control devices and systems, traffic studies, planning and design of parking facilities, roadway lighting; Traffic Impact Assessment (TIA), Introduction to Intelligent Transportation System (ITS); Fundamentals of transport economics.			

COURSE OUTCOMES AND SKILL MAPPING													
No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Comprehend** different transportation systems, functions, different modes, ITS, transportation scenario in Bangladesh	√											
2	**Identify** different geometric features of highways and evaluate safety issues considering geometric challenges		√										
3	**Design** traffic control devices, parking and street lighting recognizing the rudiments of traffic engineering			√									

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	**Comprehend** different transportation systems, functions, different modes, ITS, transportation scenario in Bangladesh	1	C2			3,4	Pop Quiz, Assignment, Final Exam
CO2	**Identify** different geometric features of highways and evaluate safety issues considering geometric challenges	2	C2			4,5	Class Test, Mid-Term, Final Exam

CO3	**Design** traffic control devices, parking and street lighting recognizing the rudiments of traffic engineering	3	C3	1, 2, 3		5,6	Class Test, Mid-Term, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	15
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 36 22
Assessment Continuous Assessment Final examination	 2 3
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE			
Week	**Lectures**	**Topics**	**Assessments**
1	1	Introduction to Course and Traffic Engineering	CT/Mid/Assignment/ Term Final
	2	Vehicle and Traffic Characteristics	
	3	Transportation Function	
2	4	Vehicle and Traffic Characteristics, Braking Distance	
	5	Driver Characteristics	
	6	Transportation System	
3	7	Elements of Design: Sight Distance	
	8	SSD on Horizontal and Vertical curve	
	9	Functional Components	
4	10	Superelevation	CT/Mid/Assignment/ Term Final
	11	Cross Sectional Element	
	12	Factors in Transportation development	
5	13	Intersection	
	14	Intersection	
	15	Transportation Modes	
6	16	Introduction to Traffic Engineering and Traffic Flow parameters	CT/Mid/Assignment/ Term Final
	17	Traffic Volume Study	
	18	Emerging Modes	
7	19	Traffic Volume Study	
	20	Speed and Delay Study	
	21	Public Transportation	
8	22	Speed and delay Study	
	23	OD survey	
	24	Land Use Transportation interaction	
9	25	Parking Study	
	26	Traffic Control Device	
	27	Transportation Network	
10	28	Traffic Sign and Marking	
	29	Terminals	
	30	Constraints and challenges	

11	31	Traffic Signal	
	32	Traffic Signal	
	33	Transportation demand	
12	34	Street Lighting	CT/Mid/Assignment/ Term Final
	35	Traffic Impact Assessment	
	36	Road Classification	
13	37	Traffic Accident	
	38	Transportation Planning	
	39	Design standard	
14	40	Transportation Planning	
	41	Transportation Planning	
	42	Constrains and challenges and revision	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C2, C3
Final Exam	60%	CO 1	C2
		CO 2	C2
		CO 3	C3
Total Marks	100%		

REFERENCE BOOKS

1. Highway Engineering by Paul H. Wright (7th Edition)
2. Transportation Engineering and Transport Planning by L.R. Kadiyali
3. Transportation Planning and Traffic Engineering by O’Flaherty.
4. A Policy on Geometric Design of Highways and Streets, American Association of State Highways and Transportation Officials, Washington, D. C., 2018.
5. Traffic and Highway Engineering, - N. J. Garber and L. A. Hoel, West Publishing Company, MN, 2010.
6. Highway capacity manual, transportation research reports, national research council, Washington D.C.
7. Geometric Design of Roads Handbook, K. M. Wolhuter, CRC Press

Spring Semester L-4, T-I

Theoretical (Core)

COURSE INFORMATION			
Course Code	: CE 451	Contact hours	: 4.00
Course Title	: Highway Materials, Pavement Design and Railway	Credit hours	: 4.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

It's a fundamental course of transportation engineering. Students will be oriented with different types of materials for road construction, pavement types including their design and rudiments of railways. After this course students are expected to identify the required type of pavement, fix its dimensions and select appropriate materials for construction. Besides students will also be able to find out the general requirements of railway.

OBJECTIVE

- To familiarize with the properties, test procedures, specifications and uses of various types of pavement materials including mix design methods.
- To acquire knowledge on characteristics, functions and types of pavements including latest development.
- To acquaint with the different design methods of rigid and flexible pavement.
- To have clear idea about road maintenance and construction equipment.
- To familiarize with low-cost road.
- To learn the basic knowledge on railway engineering, rolling stocks and tracks, signalling, stations and yards

COURSE CONTENT

Pavement materials: bituminous binders, cement, aggregates, embankment material, soil stabilization; mix design methods; low cost roads; road tests, pavement types, components and functions, fundamentals of flexible and rigid pavement, pavement stresses, traffic and loading, design of pavement using contemporary methods, construction methods of pavement, pavement distresses and road maintenance; pavement management, railway engineering: general requirements, rolling stock and tracks, stations and yards, points and crossings, signalling, maintenance operations, pavement construction equipment and uses.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Demonstrate** various types of pavements, components, functions,	√											

	development, joint and maintenance												
2	**Outline** rudiments of railway.	√											
3	D**esign** flexible and rigid pavements using various methods.			√									
4	**Demonstrate** various types of pavements, components, functions, development, joint and maintenance				√								

<u>Program Outcomes (PO)</u>:
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Demonstrate** various types of pavements, components, functions, development, joint and maintenance	1	C2			3,4	Assignment, Class Test, Mid-Term, Final Exam
CO2	**Outline** rudiments of railway.	1	C2			3,4	Assignment, Class Test, Mid-Term, Final Exam
CO3	D**esign** flexible and rigid pavements using various methods.	3	C3	1,2,3		5,6	Assignment, Class Test, Mid-Term, Final Exam
CO4	**Carry out** mix design for pavement layers with appropriate materials	3	C3	1,2,3		5,6	Assignment, Class Test, Mid-Term, Final Exam

<u>Knowledge Profile (K)</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

<u>Complex Engineering Problem (P)</u>:

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

<u>Complex Engineering Activities (A)</u>:

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

<u>Bloom's Taxonomy Levels</u>:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	15
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	36 22
Assessment Continuous Assessment Final examination	2 3
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE			
Week	**Lectures**	**Topics**	**Assessments**
1	1	Pavement: definition, Types, Characteristics, functions, layers, comparison of different types of pavements, ME design Method.	CT/Mid/Assignment/ Term Final
	2	Introduction to Railway Engineering	
	3	Bituminous Materials	
2	4	Pavement: definition, Types, Characteristics, functions, layers, comparison of different types of pavements, ME design Method.	
	5	Introduction to Railway Engineering	
	6	Properties of Bitumen	
3	7	Pavement Design Requirement	
	8	Introduction to Railway Engineering	
	9	Tests of Asphaltic Materials	
4	10	Road Test	CT/Mid/Assignment/ Term Final
	11	Stress and strain in pavement	
	12	Rail and Sleeper	
5	13	Stress and strain in pavement	
	14	Ballast, Formation and Embankment	
	15	Tests of Asphaltic Materials	
6	16	Joints in Pavement	CT/Mid/Assignment/ Term Final
	17	Material Characterization	
	18	Aggregates	
7	19	Road maintenance	
	20	Geometric Design of Tracks	
	21	Mix Design	
8	22	Design of Flexible pavement by AASHTO & Asphalt Institute Method	
	23	Points and Crossing	
	24	Mix Design	
9	25	Design of Rigid pavement by AASHTO Method	
	26	Rail Traffic Management	
	27	Mix Design	
10	28	RHD Design Method	

	29	rolling stock and tracks	
	30	Soil	
11	31	PCA design Method	
	32	stations and yards	
	33	Embankment Materials	
12	34	Low-Cost Road	CT/Mid/Assignment/ Term Final
	35	Railway Signalling	
	36	Cement	
13	37	Road Note 31	
	38	Maintenance operations	
	39	Soil Stabilization	
14	40	Construction Equipment	
	41	Soil Stabilization	
	42	Pavement: definition, Types, Characteristics, functions, layers, comparison of different types of pavements, ME design Method.	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3, CO4	C2, C3
Final Exam	60%	CO 1	C2
		CO 2	C2
		CO 3	C3
		CO4	C3
Total Marks	100%		

REFERENCE BOOKS

1. Pavement Analysis and Design by Yang H. Huang 2nd edition
2. Highway Engineering by Paul H. Wright (7th Edition)
3. Railway Engineering by Chandra, Satish, Agarwal
4. Pavement Design Guide, RHD
5. MS-2, Asphalt Mix Design Methods, Asphalt Institute
6. Fluid Mechanics by Steeter and Wylie
7. Hydraulics, Fluid Mechanics and Hydraulic Machines by R S Khurmi

Spring Semester L-4, T-I

Sessional (Core)

COURSE INFORMATION			
Course Code	: CE 452	Contact hours	: 3.00
Course Title	: Highway Materials and Transportation Engineering Design Sessional	Credit hours	: 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

It is a design course of testing and quality control of highway materials. Bituminous mix design; roadway traffic and capacity analysis. Test of aggregate for abrasion and impact by Los Angles Machine, Determination of Road way capacity and saturation flow at intersection.

OBJECTIVE

- Determine properties of aggregates and bitumen using standard methods
- Identify optimum bitumen content by Mix Design
- Estimate capacity and saturation flow of a road section

COURSE CONTENT

Laboratory tests of highway materials: tests on aggregates, tests on bitumen, California Bearing Ratio (CBR); Bituminous mix design: Marshall Method; Los Angeles Abrasion Value test on aggregates (ASTM test); Traffic Engineering: Roadway Capacity, Saturation Flow

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Determine** properties of aggregates and bitumen using standard methods	√											
2	**Determine** road way capacity and traffic saturation flow.			√									
3	I**dentify** optimum bitumen content and aggregate gradation by Mix Design				√								

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Determine** properties of aggregates and bitumen using standard methods	1	C3			4,5	Viva, Quiz, Lab Report
CO2	**Determine** road way capacity and traffic saturation flow.	3	C3	1,2,3		5,6	Viva, Quiz, Lab Report, Presentation
CO3	I**dentify** optimum bitumen content and aggregate gradation by Mix Design	4	C5		1,2	5,6	Viva, Quiz, Lab Report, Presentation

Knowledge Profile (K):
K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):
P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):
A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:
C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42

Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	15
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 36 22
Assessment Continuous Assessment Final examination	 2 3
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Determination of Aggregate Impact Value	Lab Report/Viva/Quiz
	2	Determination of Aggregate Crushing Value	
2	3	Determination of Ten Percent Fines Value	
	4	Determination of Angularity Number	
3	5	Determination of Flakiness Index	
	6	Determination of Elongation Index	
4	7	Determination of Specific Gravity of Semi-Solid Bituminous Material	Lab Report/Viva/Quiz
5	8	Determination of Loss on Heating of Oil and Asphaltic Compounds	
6	9	Determination of Penetration of Bituminous Material	Lab Report/Viva/Quiz
	10	Determination of Softening Point of Bituminous Materials	
7	11	Determination of Flash and Fire Points of Bituminous Materials	
	12	Determination of Ductility of Bituminous Materials	
8	13	California Bearing Ratio (CBR) Test	
9	14	California Bearing Ratio (CBR) Test (contd.)	
10	15	Test of aggregate for abrasion and impact by Los Angles Machine	

11	16	Marshall Method of Mix Design	
12	17	Determination of Aggregate Impact Value	Lab Report/Viva/Quiz
	18	Determination of Aggregate Crushing Value	
13	19	Determination of Roadway Capacity	Lab Report/Viva/Quiz/Presentation
14	20	Determination of Saturation Flow at Traffic Signals	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Viva	10%	CO1, CO2, CO3	C3, C5
Observation	05%	CO1, CO2, CO3	C3, C5
Report	30%	CO1, CO2, CO3	C3, C5
Presentation	05%	CO3	C3, C5
Quiz	50%	CO1, CO2, CO3	C3, C5
Total Marks	100%	CO1, CO2, CO3	C3, C5

REFERENCE BOOKS

1. ASTM testing standards for aggregate, asphalt and mixes
2. British standards for testing aggregates, BS 812
3. Standard test procedure, RHD, Bangladesh
4. MS-2, Asphalt Mix Design Methods, Asphalt Institute

Fall semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code	: CE 453	Lecture contact hours	: 2.00
Course Title	: Traffic Engineering Design and Management	Credit hours	: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

It is a course depicting traffic flow fundamentals, flow theory, network equilibrium, TIA, traffic control system and design, micro simulation of traffic and ITS, Transportation demand, supply and equilibrium and concepts of traffic managements. After this course students will be able to conduct network analysis using micro simulation software.

OBJECTIVE

- To develop a deep understanding of traffic flow characteristics structural steel
- To gain familiarity with; road traffic assignment, network equilibrium
- Able to demonstrate traffic control devises; Intersection control and design; grade separation and interchanges
- To introduced with advanced concepts of traffic management, management strategies, NMT issues and road safety.

COURSE CONTENT

Analysis of traffic flow characteristics; road traffic assignment, network equilibrium, system optimality; traffic flow theory, shockwaves, deterministic and stochastic queuing analysis; Traffic Impact Assessment (TIA); Introduction to signal optimization tools, traffic control devises; Intersection control and design; grade separation and interchanges; computer application in traffic system analysis; introduction to micro simulation and ITS: Components and Applications; Transportation demand, supply and equilibrium; Advanced concepts of traffic management, management strategies; NMT issues and road safety.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Demonstrate** various traffic flow theories	√											
2	**Comprehend** traffic signalling system, demand and micro simulation tools.		√										

<u>Program Outcomes (PO)</u>:							
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning							
COURSE OUTCOMES AND GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Demonstrate** various traffic flow theories	1	C3			4, 5	Class Test, Mid-term, Assignment, Final Exam
CO2	**Comprehend** traffic signalling system, demand and micro simulation tools.	2	C4			4, 5	Class Test, Mid-term, Assignment Final Exam

<u>Knowledge Profile (K)</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

<u>Complex Engineering Problem (P)</u>:

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

<u>Complex Engineering Activities (A)</u>:

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

<u>Bloom's Taxonomy Levels</u>:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning)	35 22

Preparation for tests and examination	
Assessment Continuous Assessment Final examination	 2 3
Total	100
TEACHING METHODOLOGY	
Lecture and Discussion, Problem Based Learning (PBL)	
TEACHING SCHEDULE	

Week	**Lectures**	**Topics**	**Assessments**
1	1	Analysis of traffic flow characteristics	Class Test/ Mid-term/Assignment/Final Exam
	2	Analysis of traffic flow characteristics	
2	4	Network equilibrium	
	5	System optimality	
3	7	Traffic flow theory	
	8	Traffic flow theory	
4	10	Deterministic and stochastic queuing analysis	Class Test/ Mid-term/Assignment/Final Exam
	11	Traffic Impact Assessment (TIA)	
5	13	Introduction to signal optimization tools	
	14	Traffic control devises	
6	16	Intersection control and design	Class Test/ Mid-term/Assignment/Final Exam
	17	Grade separation	
7	19	Interchanges	
	20	Introduction to micro simulation	
8	22	Components	
	23	Transportation demand	
9	25	Transportation supply	
	26	Demand-supply equilibrium	
10	28	Advanced concepts of traffic management	
	29	Management strategies	
11	31	NMT issues	
	32	Road safety	
12	34	Road traffic assignment	Class Test/ Mid-term/Assignment/Final Exam
	35	Shockwaves	
13	37	Introduction to ITS	

	38	Computer application in traffic system analysis	
14	40	ITS Applications;	
	41	Pedestrian Safety	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2	C3, C4
Final Exam	60%	CO1	C3
		CO2	C4
Total Marks	100%		

REFERENCE BOOKS

1. Highway Engineering by - Paul H Wright
2. Traffic Engineering and Transport Planning by L.R. Kadiyali
3. Highways – The Location, Design, Construction by Flaherty
4. Principles of Transportation Engineering by Das
5. Transportation Engineering Handbook by Geulias
6. Traffic and Highway Engineering by Garber

Fall semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code	: CE 455	Lecture contact hours	: 2.00
Course Title	: Pavement Management, Drainage and Airport Engineering	Credit hours	: 2.00

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
In this course students will learn to design airfield pavements with software and drainage for highways and airport with appropriate drainage materials. Students will gain knowledge on pavement management system, strengthening and air transportation, aircraft characteristics, configurations, lighting, marking and signage. This will be useful for the students in a later stage of their study, as well as professional life.

OBJECTIVE

- To develop deep understanding on pavement management system (PMS), pavement strengthening, drainage system for highways and airport
- To be acquainted with trends in air transportation, airport configurations and airport planning
- To become skilled at the airfield pavements design using software)

COURSE CONTENT
Pavement management systems; evaluation and strengthening of pavements; Drainage: highway drainage and drainage structures; Airports: importance, advantages and trends in air transportation, Planning and design of airports, aircraft characteristics related to airport design, Types and elements of airport planning studies, airport configuration, geometric design of the landing area, terminal area, heliports, design of airport pavements, lighting, marking and signing, airport drainage, Introduction to airside planning, design and operations software.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the principles of pavement management system, strengthening techniques, air transportation, aircraft characteristics, airport		√										

	configurations and other important aspects of airport engineering.												
2	**Design** road and airport drainage system with appropriate drainage materials to reduce the water related damage.			√									
3	**Design** airfield pavements using design software					√							

<u>Program Outcomes (PO)</u>:
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the principles of pavement management system, strengthening techniques, air transportation, aircraft characteristics, airport configurations and other important aspects of airport engineering.	2	2	-	-	3, 4	Class Test, Mid-term, Final Exam
CO2	**Design** road and airport drainage system with appropriate drainage materials to reduce the water related damage.	3	4	-	-	4, 5	Assignment, Class Test, Mid-term, Final Exam
CO3	**Design** airfield pavements using design software.	5	4	-		4, 5	Assignment, Mid-term, Final Exam

<u>Knowledge Profile (K)</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	28 25
Assessment Continuous Assessment Final examination	2 3
Total	95

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Definition of PMS, purposes & activities at different levels of PMS	Assignment/ Class Test/ Mid-term/ Final Exam
	2	Pavement condition assessment, determining & prioritizing the needs, life cycle cost analysis	
2	3	Different types of overlays, methods of overlay design	
	4	Reflection cracks and early failure of overlay	
3	5	Importance of highway drainage, surface and sub-surface drainage, typical sketches	Assignment/ Class Test/ Mid-term/ Final Exam
	6	Drainage materials: aggregates, criteria for drainage materials	

4	7	Drainage materials: Geotextiles, pipes, and drainage structures	
	8	Introduction: Airports, importance advantages, trends in air transportation	Assignment/ Class Test/ Mid-term/ Final Exam
5	9	Trends in air transportation: global, regional and national aspects (Bangladesh)	
	10	Aircraft Characteristics Related to Airport Design: Dimensional standards, landing gear configuration	
6	11	Aircraft Characteristics Related to Airport Design: Aircraft weight	
	12	Runway: Atmospheric conditions affecting aircraft performance, Basic runway length components	
7	13	Runway: declared distances, runway length calculation	
	14	Types and elements of airport planning studies	
8	15	Airport system plan, airport master plan,	
	16	Airport project plan, airport site selection	
9	17	Geometric design of the airfield: airport Design Standards, airport classifications	
	18	Airport configuration: runway	
10	19	Taxiway, terminal, heliports	
	20	Factors in structural design of flexible and rigid airfield pavements	Assignment/ Class Test/ Mid-term/ Final Exam
11	21	Historical development of FAA methods on pavement design	
	22	Introduction with FAARFIELD software	
12	23	Design with FAARFIELD	
	24	Airport lighting, marking and signage: Requirements for visual aids	
13	25	Approach lighting, threshold lighting	
	26	Airport drainage system, ponding and no-ponding condition, typical layout sketches	
14	27	Introduction to airside planning, design and operations software.	
	28	Introduction to airside planning, design and operations software.	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C2, C4, C4
Final Exam	60%	CO 1	C2
		CO 2	C4
		CO 3	C4
Total Marks	100%		

REFERENCE BOOKS

1. Pavement Analysis and Design, Yang H. Huang
2. Planning and Design of Airport, 5th Ed., Horonjeff
3. Airport Engineering Planning, Design and Development of 21^{st} Century Airports, 4^{th} Ed, Norman J. Ashford

Fall semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code	: CE 457	Lecture contact hours	: 2.00
Course Title	: Urban Transportation Planning and Management	Credit hours	: 2.00

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
This course demonstrates how to conduct an urban transport planning study, develop understanding of urban transport systems. Also enables to develop decision and policy making aids for large-scale, complex transportation systems. Upon completion of this course, students should have basic understanding of about urban transportation planning is, its theoretical backgrounds, applications, details of public transportation system, travel demand forecasting.

OBJECTIVE

- To understand current transportation planning issues, trends, policies and challenges
- To design and execute an urban transportation planning study
- To acquire effective knowledge on travel demand forecasting
- To understand the evaluation of transportation systems
- To learn about the environmental issues and sustainable transport

COURSE CONTENT
The urban transport problems and trends; road network planning; Sustainable Urban Transportation Index (SUTI);characteristics and operation of different transit and paratransit modes, travel demand and forecasting, planning transit network, estimating system costs and benefits, Transit oriented development (TOD); pricing and financing, evaluation, transit users attitude, policies and strategies for transit development in metropolitan cities; freight traffic planning and management; congestion management; environmental issues and sustainable transport; selected transport case studies.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** urban transportation issues, trends and challenges	√											

2	**Comprehend** urban transportation planning skills, especially related to travel demand forecasting		√										
3	**Identify** environmental issues and sustainable urban transport requirement and Evaluation techniques								√				

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** urban transportation issues, trends and challenges	1	C2			3,4	Class Test, Mid-Term, Final Exam
CO2	**Comprehend** urban transportation planning skills, especially related to travel demand forecasting	2	C2			4,6	Class Test, Mid-Term, Final Exam
CO3	**Identify** environmental issues and sustainable urban transport requirement and Evaluation techniques	7	C3			5,6	Class Test, Mid-Term, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A): **A1**: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity **Bloom's Taxonomy Levels**: **C1**: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 22 14
Assessment Continuous Assessment Final examination	 3 3
Total	80

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Course Overview, Urban Transportation Planning process	CT/ Assignment/Mid Term/ Term Final
	2	Urban Transport Problems and Trend	
2	3	Auto Dependency	
	4	Transit Characteristics	
3	5	Transit Characteristics	
	6	Transit User Attitude & STP	
4	7	Urban Transit Challenges	CT/ Assignment/Mid Term/ Term Final
	8	Congestion	
5	9	Congestion	
	10	Freight and Goods Movement	

6	11	TOD	CT/ Assignment/Mid Term/ Term Final
	12	TOD	
7	13	Travel demand forecasting	
	14	Trip generation	
8	15	Trip generation	
	16	Trip Distribution	
9	17	Trip Distribution	
	18	Mode choice	
10	19	Mode choice	
	20	Trip assignment	
11	21	Trip assignment	
	22	Road master Plan	
12	23	Env issues and sustainable transport	CT/ Assignment/Mid Term/ Term Final
	24	Env issues and sustainable transport	
13	25	Transit Pricing	
	26	Transport Evaluation	
14	27	Transport Evaluation	
	28	Revision	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C2, C3
Final Exam	60%	CO 1	C2
		CO 2	C2
		CO 3	C3
Total Marks	100%		

REFERENCE BOOKS

1. Urban Transportation Planning by M.D. Meyer and E. J. Miller
2. Modelling Transport by Juan de Dios Ortúzar, Luis G. Willumsen
4. Banks, James. (2002). Introduction to Transportation Engineering, 2nd Edition, McGraw-Hill Education. ISBN 978 007 1240345.
5. L.R. Kadiyali “Transportation Engineering and Transport Planning”.
*In addition, students will be asked to read book sections, journal articles, and web materials

Fall semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 459 : Intelligent Transportation System	Lecture contact hours Credit hours	: 2.00 : 2.00

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
This course includes components and application of ITS in traffic management and advanced traveler information system. After this course students are expected to apply ITS in traffic management, toll collection, freight transport and emergency evacuation.

OBJECTIVE

- To develop an understanding of ITS standards and architecture; Environmental aspects of ITS To gain familiarity with limit state design philosophy
- To demonstrate different aspects of ITS
- To understand different application of ITS

COURSE CONTENT

History of ITS, ITS standards and architecture; Environmental aspects of ITS; Enabling technologies for ITS; Introduction to mobile application for ITS; Introduction to traffic flow modeling and control; Application of ITS for advanced traffic management, advanced traveler information system, public transport, commercial vehicle operation, freeway incident detection and control, electronic toll collection; Connected vehicle technology and applications; ITS benefits, evaluation and costs.; Freight Transport and Logistics; ITS application to Emergency Evacuation of Traffic.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Demonstrate** different aspects ITS	√											
2	**Understand** different application of ITS		√										

<u>**Program Outcomes (PO)**</u>:
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **demonstrate** different aspects ITS	1	3			4, 5	Class Test, Mid-term, Assignment, Final Exam
CO2	Ability to **understand** different application of ITS	2	4			4, 5	Class Test, Mid-term, Assignment Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	35 22
Assessment Continuous Assessment Final examination	2 3
Total	100

TEACHING METHODOLOGY			
Lecture and Discussion, Problem Based Learning (PBL)			
TEACHING SCHEDULE			
Week	**Lectures**	**Topics**	**Assessments**
1	1	History of ITS	Class Test/ Mid-term/ Assignment/ Final Exam
	2	ITS standards and architecture	
2	4	Environmental aspects of ITS	
	5	Enabling technologies for ITS	
3	7	Introduction to mobile application for ITS	
	8	Introduction to traffic flow modeling	
4	10	Introduction to traffic control	Class Test/ Mid-term/ Assignment/ Final Exam
	11	Application of ITS for advanced traffic management	
5	13	Advanced traveler information system	
	14	Public transport	
6	16	Commercial vehicle operation	Class Test/ Mid-term/ Assignment/ Final Exam
	17	Freeway incident detection and control	
7	19	Electronic toll collection	
	20	Connected vehicle technology	
8	22	CAV application	
	23	ITS benefits	
9	25	ITS evaluation	
	26	ITS costs	
10	28	ITS application freight transport	
	29	ITS application freight transport	
11	31	ITS application to Emergency Evacuation of Traffic.	
	32	ITS application to Emergency Evacuation of Traffic.	
12	34	ITS application to logistics	Class Test/ Mid-term/ Assignment/ Final Exam
	35	ITS application to logistics	
13	37	ITS to TOD	
	38	ITS on traffic signal control	
14	40	ITS application to Bangladesh	
	41	ITS application to Bangladesh	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2	C3, C4
Final Exam	60%	CO1	C3
Total Marks	100%	CO2	C4
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2	C3, C4

REFERENCE BOOKS

1. Principles of Transportation Engineering by Das
2. Transportation Engineering Handbook by Geulias
3. Traffic and Highway Engineering by Garber

Fall semester L-4, T-II

Sessional (Elective)

COURSE INFORMATION

Course Code	: CE 454	Lecture contact hours	: 3.00
Course Title	: Traffic Studies and Pavement Design Sessional	Credit hours	: 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is to develop skills for designing layer thicknesses for highway and airfield pavements, conduct traffic survey and subsequent analysis, design and analysis of road intersection using micro-simulation tools that will be useful in various projects in future.

OBJECTIVE

- To develop skill on how to design layer thicknesses for highways and airfield pavement using both empirical equations/nomographs and Softwares
- To develop the skill to conduct a road condition survey, O-D survey and execute traffic volume and speed studies using field data
- To develop state of the art to analyse traffic and design the road intersection using micro-simulation software, i.e., VISSIM

COURSE CONTENT

Design of flexible and rigid pavement and airfield pavements; Geometric design; road intersection design and interchanges; traffic studies; Computer models and application packages.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Design and analyse** layer thicknesses for highways and airfield pavement using both empirical nomographs and Softwares					√							
2	**Execute** a road condition & O-D surveys and **conduct** traffic volume & speed studies using field data				√								

3	**Analyse traffic** and **design** the road intersection using micro-simulation software, i.e. VISSIM					√							

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	**Design and analyse** layer thicknesses for highways and airfield pavement using both empirical nomographs and Softwares	5	5			5	Viva/Class Assessment/ Assignment/ Quiz
CO2	**Execute** a road condition & O-D surveys and **conduct** traffic volume & speed studies using field data	4	4			4	Viva/Class Assessment/ Assignment/ Quiz
CO3	**Analyse traffic** and **design** the road intersection using micro-simulation software, i.e., VISSIM	5	5			5	Viva/Class Assessment/ Assignment/ Quiz

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels: **C1**: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create	
TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	15
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	36 22
Assessment Continuous Assessment Final examination	2 3
Total	120
TEACHING METHODOLOGY	
Lecture and Discussion, Problem Based Learning (PBL)	

TEACHING SCHEDULE

Week	**Lectures**	**Topics**	**Assessments**
1	1	Design of Highway Pavement (Flexible): Design Traffic Calculation, Thicknesses by AASHTO Method 1993	Viva/Quiz/Lab Report/ Presentation
2	2	Analysis of Highway Pavement (Flexible): Mechanistic-Empirical method, by Layered elastic system-based software	
3	3	Highway Pavement Design (Rigid): AASHTO Method	
4	4	Airport Pvt design (Flexible, Rigid) by CBR based and Westergaard Principle-based	
5	5	Airport Pvt design (Flexible, Rigid) by CBR based and Westergaard Principle-based	
6	6	Airport Pvt design (Flexible, Rigid) by FAARFIELD	
7	7	Design of Highway Pavement (Flexible): Design Traffic Calculation, Thicknesses by AASHTO Method 1993	

8	8	Road condition survey (objects, geometry, elevation, sign, marking, signals)	Viva/Quiz/Lab Report/ Presentation
9	9	Traffic volume study and OD survey	
10	10	Traffic speed survey (SMS, TMS, Spot Speed)	
11	11	Design of intersection, signal design, lane design, ramp design	
12	12	Traffic Analysis and design of Intersection with VISSIM	
13	13	Traffic Analysis and design of Intersection with VISSIM	
14	14	Traffic Analysis and design of Intersection with VISSIM	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Assignment Report & Class Assessment	50%	CO1, CO2, CO3	5, 4
Quiz	50%	CO 1	5
		CO 2	4
		CO 3	5
Total Marks	100%		

REFERENCE BOOKS

1. Pavement Analysis and Design, Yang H. Huang
2. Planning and Design of Airport, 5th Ed. – Horonjeff
3. AASHTO Guide for Design of Pavement Structures 1993
4. Traffic Engineering and Transportation Planning – Kadiyali
5. Highway Capacity Manual, TRB, USA
6. FAA Advisory Circular 150/5320-6E

7.4 Environmental Engineering

Spring Semester L-3, T-I

Theoretical (Core)

COURSE INFORMATION			
Course Code Course Title	: CE 331 : Water Supply Engineering	Lecture contact hours Credit hours	: 3.00 : 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course provides an overview to different aspects of Environmental Engineering. The interconnectedness of the environmental system is emphasized. Students will also learn to deal with technical aspects of drinking water treatment, collection and distribution, and will pay attention to the choice of technologies and tools, ranging from low-cost to advanced options, which will be useful in various projects in the later semesters and in their professional life.

OBJECTIVE

- To develop a basic understanding of environmental engineering especially on water supply engineering.
- To learn water quality criteria and standards, and their relation to public health, environment and urban water cycle
- To gain familiarity with drinking water supply systems, including water transport, treatment and distribution.
- To understand physical, chemical and biological phenomena, and their mutual relationships, occurring within water supply systems.
- To recognize water quality concepts and their effect on treatment process selection.

COURSE CONTENT

Introduction to Environmental Engineering: water, sanitation, ecology and environment; climate change; biodiversity; contemporary environmental issues.

Water Supply Engineering: Water requirement in urban (water demand, population prediction, water demand for street fire hydrant and interior fire protection) and rural communities; the hydrologic cycle and water availability; water supply sources; groundwater exploration: aquifer properties and groundwater flow, well hydraulics, water well design, drilling, construction and maintenance; shallow hand tubewells, deep tubewells, deep set pumps, pond sand filter, rain water harvesting system and alternative water supplies for problem areas. Water supply scenario in Bangladesh and SDG targets.

Surface water collection and transportation; pumps and pumping machineries; water distribution systems; fire hydrants; water meters; water loss control (auditing, unaccounted for water, leak detection and water conservation), Analysis and design of the distribution network.

Water quality requirements; water treatment: plain sedimentation, coagulation, flocculation, filtration, disinfection; miscellaneous treatment methods; low cost treatment methods (arsenic/iron removal plants etc.) for rural communities; water safety plans; Advanced oxidation

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	To **understand** the basic concept of ecology, environment, climate change and various component of water supply engineering.	√											
2	To **estimate** the fresh water demand and assess the requirements for preferred water supply system in urban and rural areas.	√											
3	To **design** construct efficient and cost-effective different components of water treatment plant.			√									
4	To **apply** Engineering perception to select suitable options for water supply for economic, public health, environment, and sustainability.							√					

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods

CO1	Ability to **understand** the basic concept of ecology, environment, climate change and various component of water supply engineering.	1	C2	1	-	1, 3	Class Test, Mid-term, Final Exam
CO2	Ability to **estimate** the fresh water demand and assess the requirements for preferred water supply system in urban and rural areas.	1	C2	1	-	3	Class Test, Mid-term, Final Exam
CO3	Ability to **design** construct efficient and cost-effective different components of water treatment plant.	3	C4	1,2	-	4	Class Test, Mid-term, Final Exam
CO4	Ability to **apply** Engineering perception to select suitable options for water supply for economic, public health, environment, and sustainability.	7	C3	1,3	-	5	Class Test, Mid-term, Group Assignment Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning	09

Tutorial/ Assignments (3 hours/week x 3weeks)	
Independent Learning	
Individual learning	18
Preparation for tests and examination	46
Assessment	
Continuous Assessment	2
Final examination	3
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Tutorials, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	**Lectures**	**Topics**	**Assessments**
1	1	Background of Environmental Engineering, water supply, health and sanitation, history and development of water supply Engg.	Midterm
	2	Importance of water supply Eng., Elements of public water supply, Sources of water supply	
	3	Environment and Environmental impacts on Human Life, Water supply, health and sanitation, Ecology and Environment, Role of Environmental Engineer	
2	4	Population Estimation and water demand forecasting	CT-1
	5	Fire demand calculation and fire hydrant design	
	6	Suitability of sources with regards to quantity and quality, Choice of sources for water supply	Mid Term
3	7	Aquifer properties, basic definitions, types of aquifers, confined and unconfined aquifers	
	8	Groundwater hydraulics, porosity, seepage, infiltration, permeability	
	9	Surface water collection units, Water treatment units	
4	10	Darcy's law, discharge equation for confined aquifers with example problems	
	11	Discharge equation for unconfined aquifers with example problems	
	12	Water distribution system, Distribution methods	

	13	Withdrawal of excessive groundwater, consequences of groundwater abstraction	
5	14	Basic concept of water well design, sieve analysis, bore hole construction	
	15	Water transmission line design	
	16	Gravel pack design	
6	17	Well drilling and construction	
	18	Single pipe design, Serial and branched networks	
	19	Water well maintenance	Group Assignment, Final Exam
7	20	Problems of groundwater in Bangladesh	
	21	Looped networks, Hardy Cross Method	
	22	Pump and pumping machineries, Requirement of water pump	
8	23	Water impurities, water quality requirements	
	24	Water quality standards	CT-2, Final Exam
	25	Plain sedimentation	
9	26	Coagulation, Flocculation	
	27	Pump performance curve	
	28	Filtration	
10	29	Disinfection	
	30	Surface water intake design	Final Exam
	31	Iron and Manganese removal	
11	32	Arsenic removal	
	33	water supply in coastal saline affected areas	
	34	Alternative and Low-cost water supply options	CT-4, Final Exam
12	35	Taste and odour control	
	36	Water softening	
	37	Auditing of water, Leak detection in water mains, Using water efficient appliances and fixture	
13	38	Advanced Oxidation, Membrane technologies – reverse osmosis	
	39	Water supply scenario in Bangladesh and SDG targets	Final Exam
14	40	Water safety through water safety plans , Water demand management, Water charging/ tariff, Water conservation	

	41	Developing a WSP	
	42	Review of water treatment options with examples	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2	C2, C2
Final Exam	60%	CO3	C4
		CO4	C3
Total Marks	100%		

REFERENCE BOOKS

1. Water Supply Engg. MA Aziz.
2. Water Supply and Sanitation, M Feroze Ahmed and MM Rahman.
3. Principles of Water Treatment, Kerry J. Howe, David W. Hand.
4. Water Safety Plan (WSP) – A Risk Based Approach for Water Safety 1st Ed., ITN-BUET.
5. Water and Environmental Engineering: M. Habibur Rahman, Abdullah Al-Muyeed, 1st Ed., ITN-BUET.

Spring Semester L-3, T-I

Sessional (Core)

COURSE INFORMATION

Course Code Course Title	: CE 332 : Environmental Engineering Sessional-I	Lecture contact hours Credit hours	: 3.00 : 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This is the practical course on environmental engineering where students will be trained and practiced on various water and wastewater sampling and testing methods. Experience gained from this course will be used in later semesters and also in professional life.

OBJECTIVE

- To impart knowledge to determine and analyse different parameters and substances in water.
- To make the students efficient in performing different environmental experiments to satisfy specific needs and interpret the findings.
- To introduce the students with standard procedure, how the test of water samples are conducted according to the standard code.

COURSE CONTENT

Water and wastewater sampling techniques, sample preservation, physical, chemical and biological tests of water and wastewater; breakpoint chlorination, alum coagulation, sampling and laboratory analysis of air, particulate matter, sampling and laboratory analysis of soil and solid waste, sampling and laboratory analysis of noise.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **understand** the basic concept of water quality parameters	√											
2	Ability to **estimate** different types of water and quality parameters.				√								

3	Ability to **use** modern instruments to analyze water quality parameters following standard test protocol in terms of Engineering practice.					√							
4	Ability to **investigate** the water quality parameters against their standards and also to interpret data in order to ensure safe water supply requirements to protect public health and environment		√								√		

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	To **understand** the basic concept of water quality parameters	1	C2	1	-	3	Viva, Quiz, Lab Report
CO2	To **estimate** different types of water and air quality parameters.	4	C2	1	-	3	Viva, Quiz, Lab Report
CO3	To **use** modern instruments to analyze water quality parameters following standard test protocol in terms of Engineering practice.	5	C3	1,5	-	6	Viva, Quiz, Lab Report

CO4	To **investigate** the water quality parameters against their standards and also to interpret data in order to ensure safe water supply requirements to protect public health and environment	2, 10	C4	1,3	4	4	Viva, Quiz, Open Ended Lab

<u>Knowledge Profile (K)</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

<u>Complex Engineering Problem (P)</u>:

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

<u>Complex Engineering Activities (A)</u>:

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

<u>Bloom's Taxonomy Levels</u>:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (1 hours/week x 10 weeks) Experiment (1 hr/week X10 weeks) Data analysis and calculation (0.75 hr/week X 10 weeks)	 10 10 7.5
Guided Learning Report Writing (2 hours/week x 10 weeks)	20
Independent Learning Preparation for tests and examination	07
Assessment Quiz Viva Class Performance(0.25 hr/week X 10 weeks)	 2 1 2.5
Total	60

TEACHING METHODOLOGY
Lecture and Discussion, Tutorials, Problem Based Learning (PBL)

TEACHING SCHEDULE			
Week	**Experiment No**	**Name of the Experiment**	**Assessment**
1	Introduction	Introduction, units of measurements, sampling procedure	Viva, Class Assessment, Report, Open Ended Lab, Quiz -1
	1	Determination of pH of water	
	2	Determination Color of water	
2	3	Determination Turbidity of water	
	4	Determination TS, TDS, TSS of water	
3	5	Determination of CO2	
	8	Determination of Chloride of Water	
4	6	Determination of Alkalinity of water	
	7	Determination of Hardness of water	
5		**Quiz --- 1**	
6	9	Determination of Biochemical Oxygen Demand (BOD5)	Viva, Class Assessment, Report, Open Ended Lab, Quiz -2
	10	Determination of Chemical Oxygen Demand (COD)	
7	11	Determination of Total Iron of Water	
	12	Determination of Arsenic contamination of water	
8	13	Alum Coagulation	
	14	Determination of Total and Fecal Coliform of water	
9	15	Break Point Chlorination	
10	16	Noise survey, data collection and laboratory analysis	
11	17	Air quality survey, data collection and laboratory analysis	
12		Review Lectures and Viva/Assessment	
13		**Quiz --- 2**	
14		**No class**	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**

Continuous Assessment (Class Assessment, Report)	20%	CO1, CO2, CO3	C2, C3
Open Ended Lab	20%	CO4	C4
Viva Quiz	10% 50% (25% + 25%)	CO1, CO2, CO3, CO4	C2, C3, C4
Total Marks	100%		

REFERENCE BOOKS

1. A Textbook of Water Supply Engineering by – M.A. Aziz
2. Water Supply and Sanitation by – Ahmed and Rahman
3. Laboratory Manual

Fall Semester L-3, T-II

Theoretical (Core)

COURSE INFORMATION			
Course Code Course Title	: CE 333 : Wastewater and Sanitation Engineering	Lecture contact hours Credit hours	: 4.00 : 4.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This is the second course on environmental engineering where students will be presented with basic knowledge on waste water technology and sanitation, design and construction of sewera, STP and ETP plant and sanitation system. Students will also learn about the environmental impact assessment. Knowledge gained from this course will be used in later semester and also in professional life.			
OBJECTIVE			
• To gain knowledge on the basics of waste water technology and sanitation options. • To become skilled at the design and construction of sanitary sewer, storm sewer, waste water treatment plant. • To learn about the details of sewage treatment methods and design of treatment units. • To understand the importance of sludge management and learn about the sludge treatment facilities. • To be acquainted with the sanitation technologies, especially practiced in low-income and developing countries around the world and learn to design those facilities knowing the appropriateness of technologies suitable to specific site condition.			
COURSE CONTENT			
Introduction to waste management: liquid waste, solid waste. Introduction to environmental pollution (water pollution, air pollution, noise pollution). Wastewater Engineering: introduction; estimation of wastewater; wastewater collection systems; hydraulics of sewer; design, construction and maintenance of sanitary sewer and storm drainage system; sewer appurtenances. Microbiology of wastewater; wastewater characteristics; wastewater treatment and disposal; sludge treatment and disposal; Sanitation and health; sanitation coverage in Bangladesh and SDG targets; onsite sanitation system including fecal sludge management (FSM), pour-flush toilets, septic tank system, Anaerobic Baffled Reactor (ABR); decentralized wastewater treatment systems (DEWATS). Plumbing system. Introduction of EIA; Sustainability of water and sanitation services.			

COURSE OUTCOMES AND SKILL MAPPING													
No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **understand** the basic concept of wastewater Engineering, environmental pollution, and environment safety and management.	√											
2	Ability to **comprehend** the waste water, solid waste and human waste generation rate and **estimate** the requirements for preferred sanitation system in urban as well as rural areas.	√											
3	Ability to **design** efficient sewerage system and STP with appropriate consideration for public health and safety.			√									
4	Ability to **Apply** engineering perception for environmental risks identification and wastewater treatment option selection in terms of economic, public health, Environment and sustainability.							√					

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods

CO1	Ability to **understand** the basic concept of wastewater Engineering, environmental pollution, and environment safety and management.	1	C2	1	-	1,3	Class Test, Final Exam
CO2	Ability to **comprehend** the waste water, solid waste and human waste generation rate and **estimate** the requirements for preferred sanitation system in urban as well as rural areas.	1	C3	1	-	3	Class Test, Final Exam
CO3	Ability to **Apply** Engineering perception to construct sewerage networks and building plumbing in terms of economic, public health, Environment and sustainability.	3	C4	1,3	-	3,4	Midterm, Final Exam
CO4	Ability to **design** efficient sewerage system and STP with appropriate consideration for public health and safety.	7	C5	1,3	-	5	Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (4 hours/week x 14 weeks)	56
Guided Learning Tutorial/ Assignments (4 hours/week x 3weeks)	12
Independent Learning Individual learning Preparation for tests and examination	 22 65
Assessment Continuous Assessment Final examination	 2 3
Total	160
TEACHING METHODOLOGY	
Lecture and Discussion, Tutorials, Problem Based Learning (PBL)	
TEACHING SCHEDULE	

Weeks	Lectures	Topics	Assessment
1	1	Importance of Waste water Engg. Introduction of water supply and waste water production	Final exam
	2	Significance of waste water, where does it come? Generation of waste water	
	3	Water, sanitation and health, Objectives of environmental sanitation Classification of Wastes and Sanitation Systems	CT-1, Final exam
	4	Functions of sanitation system Types of sanitation system, Appropriateness of sanitation system Criteria for a good sanitation system	
2	5	Estimation of waste water flow, discharge computation	Final exam
	6	Per capita waste water generation, Daily discharge, seasonal variation, peak discharge	
	7	On-site sanitation systems for rural & low-income urban communities Simple pit technology – design considerations and design	Final exam
	8	Two pit latrine systems – design considerations and design	
3	9	Characteristics of waste water, dissolved solids, suspended solids	Midterm, Final exam
	10	Nutrients in waste water and oxygen demand	

	11	Ventilated Improved Pit (VIP) Latrine, Reed Odorless Earth Closet (ROEC)	
	12	Pour-flash sanitation technologies – design considerations and design	
4	13	BOD, COD, DO	
	14	Environmental problems of untreated waste water	
	15	Pour-flash sanitation technologies – design considerations and design	
	16	Septic tank – design considerations	
5	17	Eutrophication, turbidity and water pollution	
	18	Sewer, Sewerage and sewage, Collection of waste water, combined system and separate system	
	19	Soak pit design	
	20	Disposal of septic tank effluent	
6	21	Sewer hydraulics, Manning's equations, curved sewers	CT-2, Final exam
	22	Derivation of Partial flow equations, hydraulic element diagrams	
	23	Small Bore Sewerage (SBS) system Changes in design criteria for SBS compared to Conventional Sewerage System	
	24	Simplified/ shallow sewerage system, Design principles and design	Final exam
7	25	Basic considerations of Sanitary sewer and storm sewer design	
	26	Example of sanitary sewer design of a community	
	27	Ecological sanitation technologies	
	28	Composition and types of sewage, Physical, chemical and biological characteristics of sewage, Environmental significance of contaminants	
8	29	Sulfide generation, sewer inspection, construction and maintenance of sewers	
	30	Sewer appurtenances, manhole, Sewer test	CT-3, Final exam
	31	Sewage treatment – purpose, phases and unit operations, Preliminary treatment methods – Screening, cutting screen or comminutors and grit chambers	
	32	Preliminary treatment methods – Skimming tank, preaeration and flow equalization	
9	33	Importance, history and development of plumbing system	
	34	Design of plumbing system for an apartment	

	35	Primary treatment methods – Sedimentation, septic tank (review)	Final exam
	36	Primary treatment methods – Imholf tank, dissolved air flotation	
10	37	Introduction to EIA,	
	38	Example of an EIA document	
	39	Secondary treatment – purpose, biological treatment mechanism Important organisms involved in biological treatment	
	40	Role of bacteria in sewage treatment, Bacterial growth pattern in biological treatment, Relation between Food/Microorganism (F/M) ratio and biomass settling characteristics	
11	41	Solid waste problems in Dhaka City	
	42	SWM: Composting and sanitary landfill	
	43	Types of biological treatment process, Activated sludge process Significance of F/M ratio in activated sludge process	
	44	Trickling Filter process – mechanisms and biological processes Advantages, disadvantages, influencing factors in trickling filter process, Design of trickling filter	
12	45	Sustainability of water and sanitation services	CT-4, Final exam
	46	participatory development approach in water and sanitation sector	
	47	Waste stabilization ponds – process involved, advantages, disadvantages, Types of stabilization ponds	
	48	Anaerobic pond, facultative pond and maturation ponds, Design preliminaries for waste stabilization ponds	Final exam
13	49	Community management of water and sanitation services; introduction to environment	
	50	Introduction of food sanitation	
	51	Design of waste stabilization ponds	
	52	Effluent disposal methods	
14	53	E-waste	
	54	Env Risk Assessment	
	55	Sludge – types, characteristics, Collection of sludge	

	56	Importance of sludge management, Sludge treatment and disposal methods	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C2, C3, C4
Final Exam	60%	CO1	C2
		CO2	C3
		CO3	C4
		CO4	C5
Total Marks	100%		

REFERENCE BOOKS

1. Environmental Engineering - Howard S. Peavy, Donald R. Rowe.
2. Water Supply and Sanitation - M Feroze Ahmed and MM Rahman.
3. Wastewater Engineering- Metcalf and Eddy.
4. Environmental Sanitation, Wastewater Treatment and Disposal – Tanveer Ferdous Saeed, Abdullah Al-Muyeed, Tanvir Ahmed.
5. Water Supply and Sewerage- Terence J. McGhee.

Fall Semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 431 : Natural Resources and Renewable Energy	Lecture contact hours Credit hours	: 2.00 : 2.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			

SYNOPSIS/RATIONALE

This course explains about different aspects of natural resources including the classification, depletion, protection and management. In this course, students will be introduced with the various technologies related to sustainable extraction of natural resources and optimum utilization of renewable energy which will be useful in their professional life.

OBJECTIVE

- To develop a deep understanding about the classification and importance of natural resources and renewable energy.
- To gain familiarity with various methods of extraction, depletion, protection and management of natural resources..
- To apply modern technologies to extract and utilize natural resources and renewable energy ensuring a non-declining stream of benefits for all.

COURSE CONTENT

Classification, extraction, depletion, protection and management of natural resources.
Overview, history, mainstream technologies; wind power, hydropower, solar energy, biomass, bio-fuel, geothermal energy, gallery, commercialization, growth of renewable, economic trends, hydroelectricity, wind power development, solar thermal, photovoltaic development, photovoltaic power stations, bio fuel development, geothermal development and emerging technologies of renewable energy.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

1	Ability to **understand** various aspects of natural resources and renewable energy including their historical importance in the economic development of the country.	√											
2	Ability to **identify** different resources management techniques and their corresponding impacts on environment.		√					√					
3	Ability to **apply** various modern technologies for the extraction and protection of natural resources.					√							

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	To **understand** various aspects of natural resources and renewable energy including their historical importance in the economic development of the country.	1	C2	1	---	1	Class Test, Mid-term, Pop quiz, Final Exam
CO2	To **identify** different resources management techniques and their corresponding impacts on environment.	2, 7	C2	1,2	---	4, 7	Class Test, Mid-term, Pop quiz, Final Exam
CO3	To **apply** various modern technologies	5	C3	1,5	---	6	Assignment, Pop quiz

	for the extraction, and protection of natural resources.						

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 22 15
Assessment Continuous Assessment Final examination	 2 3
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Classification and sources of natural resources	CT/ Assignment-1, Final Exam
	2	Extraction techniques of natural resources	
2	3	Depletion and protection of natural resources	
	4	Management techniques of natural resources	

3	5	Impact of management techniques of natural resources	
	6	Overview of history of mainstream technologies related to natural resources	
4	7	Overview of history of mainstream technologies related to natural resources	
	8	Introduction to wind power and hydropower	
5	9	Introduction to wind power and hydropower	
	10	Concept of solar energy, biomass, bio-fuel	
6	11	Concept of solar energy, biomass, bio-fuel	Mid Term/ Assignment-2, Final Exam
	12	Introduction to geothermal energy	
7	13	Importance of renewable energy and its corresponding growth	
	14	Importance of renewable energy and its corresponding growth	
8	15	Economic trends of renewable energy and resources	
	16	Economic trends of renewable energy and resources	
9	17	Introduction to hydroelectricity	
	18	Introduction to hydroelectricity	
10	19	Concept of wind power development	
	20	Importance of solar and thermal power development	
11	21	Importance of solar and thermal power development	
	22	Introduction to photovoltaic development	
12	23	Introduction to photovoltaic power stations	CT/ Assignment-3, Final Exam
	24	Introduction to bio fuel development	
13	25	Introduction to geothermal development	
	26	Emerging technologies of renewable energy	
14	27	Emerging technologies of renewable energy	
	28	Review Class	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment	40%	CO1, CO2, CO3	C2, C3

(Class assignments/ CT/ Mid Term/ Active Class Participation)			
Final Exam	60%	CO1	C2
		CO2	C2
		CO3	C3
Total Marks	100%		

REFERENCE BOOKS

1. Encyclopedia of Energy, Natural Resource, and Environmental Economics – Jason Shogren (1st Edition)
2. Natural Resources Available Today and in the Future – Erik Dahlquist & Stefan Hellstrand
3. Renewable Energy Resources: Basic Principles and Applications – G.N. Tiwari & M.K. Ghoshal

Fall Semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 433 :Solid and Hazardous Waste Management	Lecture contact hours Credit hours	: 2.00 : 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

In this course students will be introduced about solid and hazardous waste management and will learn about different aspects of these wastes including their types, sources, properties and various treatment methods. Students will also learn about the integrated solid waste management and life cycle inventory analysis.

OBJECTIVE

- To identify the characterization of different kinds of solid and hazardous wastes and their treatment.
- To analyze health and environmental issues related to solid waste management.
- To solve solid waste and hazardous problem for ensuring public health safety.

COURSE CONTENT

Solid Waste Management: sources and types of solid wastes; physical and chemical properties of solid wastes; solid waste generation (Separation at source); on-site handling, storage and processing; collection of solid wastes; transfer stations and transport; resources and energy recovery and recycling (Reduction, Re-used & Recycling- 3R concept); decomposition of solid waste: anaerobic treatment/biogasification, aerobic treatment/composting; thermal treatment, land disposal. Hazardous Waste Management: identification, sources and characteristics of hazardous wastes; different types of hazardous waste, hazardous waste management plant; methods of treatment (physical, chemical, biological and thermal treatment; fixation/stabilization) and disposal (landfill and ocean dumping, engineering storage, incineration and deep burial) of hazardous waste, nuclear waste management. Healthcare waste management, categories of healthcare waste, treatment methods of healthcare waste. Integrated solid waste management and live cycle inventory analysis.

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to **understand** the basic concepts of solid waste management from generation to disposal at different sources and	√											

	integrated waste management.												
2	Ability to **comprehend** and **estimate** various kinds of solid wastes, and their corresponding collection, sorting and treatment methods.	√											
3	Ability to **design** waste generation, processing, routing, and collection systems.			√									
4	Ability to **select** the most appropriate waste management system in terms of sustainability							√					

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **understand** the basic concepts of solid waste management from generation to disposal at different sources and integrated waste management.	1	C2	1	--	3	Assignment, Pop quiz, Final Exam
CO2	Ability to **comprehend** and **estimate** various kinds of solid wastes, and their corresponding collection, sorting and treatment methods.	1	C2	1	--	3	Class Test, Mid-term, Pop quiz, Final Exam
CO3	Ability to **design** waste generation, processing, routing, and collection systems.	3	C4	1,3	--	3	Class Test, Mid-term, Pop quiz, Final Exam

CO4	Ability to **select** the most appropriate waste management system in terms of sustainability	7	C5	1,3	--	3	Class Test, Mid-term, Pop quiz, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 22 15
Assessment Continuous Assessment Final examination	 2 3
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	**Lectures**	**Topics**	**Assessments**
1	1	Sources and types of solid wastes	CT/ Assignment-1, Final Exam
	2	Physical and chemical properties of solid wastes	
2	3	Solid waste generation (Separation at source)	

	4	On-site handling, storage and processing of solid wastes	
3	5	Collection of solid wastes: transfer stations and transport	
	6	Collection of solid wastes: transfer stations and transport	
4	7	Resources and energy recovery and recycling (Reduction, Re-used & Recycling- 3R concept)	
	8	Resources and energy recovery and recycling (Reduction, Re-used & Recycling- 3R concept)	
5	9	Decomposition of solid waste: anaerobic treatment/biogasification,	
	10	Decomposition of solid waste: aerobic treatment/composting;	
6	11	Thermal treatment and land disposal of solid wastes	Mid Term/ Assignment-2, Final Exam
	12	Identification, sources and characteristics of hazardous wastes	
7	13	Different types of hazardous waste	
	14	Hazardous waste management plant	
8	15	Methods of treatment of hazardous wastes (physical and chemical methods)	
	16	Methods of treatment of hazardous wastes (biological and thermal treatment)	
9	17	Methods of treatment of hazardous wastes (fixation/stabilization)	
	18	Disposal (landfill and ocean dumping) of hazardous waste	
10	19	Disposal (engineering storage, incineration and deep burial) of hazardous waste	
	20	Nuclear waste management	
11	21	Healthcare waste management	
	22	Categories of healthcare waste	
12	23	Treatment methods of healthcare waste	CT/ Assignment-3, Final Exam
	24	Treatment methods of healthcare waste	
13	25	Integrated solid waste management	
	26	Integrated solid waste management	
14	27	Life cycle inventory analysis	

	28	Review Class	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C2, C4
Final Exam	60%	CO2	C2
		CO3	C4
		CO4	C5
Total Marks	100%		

REFERENCE BOOKS

1. Solid and Hazardous Waste Management – M. Habibur Rahman & Abdullah Al-Muyeed (First Edition, ITN-BUET)
2. Solid and Hazardous Waste Management – PM Cherry
3. Solid Waste Management (Principles and Practice) - Ramesha Chandrappa & Diganta Bhusan Das (Springer)

Fall Semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 435 : Environmental Pollution Management	Lecture contact hours Credit hours	: 2.00 : 2.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This is a course where students will be able to know about different reasons and sources of environmental pollution including water and air. Students will be able to learn the air and water pollution control measures and technologies. Theories of dissolved oxygen model, air quality model will be introduced to the students.			
OBJECTIVE			
• To gain knowledge on the basics of Environmental pollution. • To become skilled at controlling surface, marine and groundwater water pollution • To get acquainted with technologies of controlling air pollution • To devise the theories for developing dissolved oxygen model			
COURSE CONTENT			
Environmental pollution and its Control; water pollution - sources and types of pollutants; waste assimilation capacity of streams; dissolved oxygen modelling; ecological balance of streams; industrial pollution; heavy metal contamination; detergent pollution and eutrophication; groundwater pollution; marine pollution; pollution control measures: water quality monitoring and management. Concepts of wetlands. Air pollution: sources and types of pollutants; effects of various pollutants on human health, materials and plants; air pollution meteorology; global warming, climate change and ozone layer depletion; air pollution monitoring and control measures; introduction to air quality models. Noise pollution and control measures.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	To **identify** causes, effects and sources of water and air pollution in the surrounding environment	√											

2	To **Analyze** water and air pollution data to solve hands on problems to **design** different treatment options to limit such pollution		√										
3	To **Apply** different pollution controlling measures for securing public health							√					

<u>**Program Outcomes (PO)**</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	To **identify** causes, effects and sources of water and air pollution in the surrounding environment	1	C2	1	--	1	Class Test, Mid-term, Pop quiz, Final Exam
CO2	To **Analyze** water and air pollution data to solve hands on problems to **design** different treatment options to limit such pollution	2	C4	1	--	4	Class Test, Mid-term, Pop quiz, Final Exam
CO3	To **Apply** different pollution controlling measures for securing public health	7	C3	1,3	--	7	Final Exam

<u>**Knowledge Profile (K)**</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

<u>**Complex Engineering Problem (P)**</u>:

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	22 15
Assessment Continuous Assessment Final examination	2 3
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Weeks	Lectures	Topics	Assessment
1	1	Introduction to Environment, Importance of pollution studies	CT/ Assignment-1, Final Exam
	2	Sources of various Env Pollution; water, air, land	
2	3	Water Pollution-Sources and Types of Pollutants	
	4	Surface water pollution; river pollution	
3	5	River pollution around Dhaka City, present scenario	
	6	Causes of river pollution, sewage and industrial water	
4	7	Effects of river water pollution on surrounding Environment	CT/ Assignment-2, Final Exam

	8	Waste assimilation capacity, Eutrophication	
5	9	Dissolved Oxygen, BOD and COD, BOD example problem	
	10	DO Sag curve, Ecological balance of streams	
6	11	Water Quality Index	Mid Term/ Assignment-3, Final Exam
	12	Industrial pollution and river water quality	
7	13	Marine Pollution, Groundwater pollution	
	14	Wetland and surface water pollution	
8	15	Introduction to air pollution	
	16	Sources and types of Air pollutants;	
9	17	Effects of various pollutants on human health, materials and plants;	
	18	Air pollution meteorology	
10	19	Air pollution meteorology	
	20	Introduction to air quality models.	
11	21	Air Diffusion Model, Gaussian Plume	
	22	ozone layer depletion; acid rain	CT/ Assignment-4, Final Exam
12	23	Air pollution monitoring	
	24	Global warming, climate change	
13	25	Control of air pollution	
	26	Control of air pollution	
14	27	Case Study of Air Pollution	
	28	Review of Air quality Standard and Air Diffusion Model	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2	C2, C4
Final Exam	60%	CO1	C2

		CO2	C4
		CO2	C3
Total Marks	100%		
REFERENCE BOOKS			

1. Environmental Engineering-Howard S. Peavy
2. Environmental Pollution and Control (4th Ed) Author(s):J. Jeffrey Peirce, Ruth F. Weiner and P. Aarne Vesilind
3. Air Pollution Control : A Design Approach - C David Cooper
4. Environmental Control and Public Health Water Pollution Control - Suresh T. Nesaratnam
5. Principles of Water Treatment, Kerry J. Howe, David W. Hand

Fall Semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 437 : Climate Change and Disaster Management	Lecture contact hours Credit hours	: 2.00 : 2.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This is a course where students will be able to know about different reasons and sources of environmental hazards. Students will be able to learn the causes of climate change, its impact in human life and nature. Also theories of vulnerability assessment, disaster management, water scarcity in coastal regions, other agricultural and groundwater problems will be introduced to the students so that it can help them in their professional life to mitigate environmental risks.			
OBJECTIVE			
• To gain knowledge on the basic causes, source and impacts of climate change and related hazards. • To get acquainted with the reasons and mitigation process of climate change. • To apply the concept of disaster preparedness and management.			
COURSE CONTENT			
Brief description of various types, nature, sources, causes and impacts of Environmental hazards experienced in Bangladesh. Cyclones, storm surges, tsunami, flood, salinity intrusion due to sea level rise, water logging and inundation, food insecurity, river bank erosion, river sedimentation problem, extreme droughts, groundwater level depletion, agricultural damages, shortages of fresh water in coastal region, vulnerability assessment, Disaster management, technologies for warning system, role of information in disaster, disaster preparedness. History of natural disaster, Classification of natural disasters, sources of natural disaster, causes and effects of natural disasters.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Identify** the root cause of environmental hazards and probable reasons of climate change and its impacts on human life.		√										

2	**Understand** the concept of disaster preparedness and management		√										
3	**Apply** modern technologies for mitigating disaster risk, issuing early warning and initiating rescue operation					√							

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Identify** the root cause of environmental hazards and probable reasons of climate change and its impacts on human life.	2	C2	1	-	1	Class Test, Mid-term, Pop quiz, Final Exam
CO2	**Understand** the concept of disaster preparedness and management	2	C2	1	-	3	Class Test, Mid-term, Pop quiz, Final Exam
CO3	**Apply** modern technologies for mitigating disaster risk, issuing early warning and initiating rescue operation	5	C3	1,3	-	7	Class Test, Mid-term, Pop quiz, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	22 15
Assessment Continuous Assessment Final examination	2 3
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Weeks	Lectures	Topics	Assessment
1	1	Introduction to Climate change and related hazards	CT/ Assignment-1, Final Exam
	2	Sources, causes of various Climate related Environmental hazards	
2	3	Impacts of various Environmental hazards	
	4	Introduction to different types of natural disaster	
3	5	Effect and causes of Cyclones, storms surges, flood and salinity intrusion for sea level rise	

	6	Effect and causes of Cyclones, storms surges, flood and salinity intrusion for sea level rise		
4	7	Water logging and inundation, food scarcity	CT/ Assignment-2, Final Exam	
	8	River bank erosion causes and solution		
5	9	River sedimentation problem and droughts		
	10	Groundwater level depletion and agricultural damages mitigation processes		
6	11	Salinity problem in drinking water in coastal region	Mid Term/ Assignment-3, Final Exam	
	12	Salinity problem in drinking water in coastal region		
7	13	History of natural disaster and classification		
	14	History of natural disaster and classification		
8	15	Sources and causes of natural disaster		
	16	Sources and causes of natural disaster		
9	17	Effects of natural disaster		
	18	Effects of natural disaster		
10	19	Vulnerability Assessment		
	20	Vulnerability Assessment		
11	21	Disaster management and risk mitigation		
	22	Disaster management and risk mitigation	CT/ Assignment-4, Final Exam	
12	23	Technologies for warning system		
	24	Technologies for warning system		
13	25	Information role during disaster		
	26	Information role during disaster		
14	27	Disaster preparedness		
	28	Disaster preparedness		

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment	40%	CO1, CO2, CO3	C2, C3

(Class assignments/ CT/ Mid Term/ Active Class Participation)			
Final Exam	60%	CO1	C2
		CO2	C2
		CO3	C3
Total Marks	100%		

REFERENCE BOOKS

1. Climate Change, Disaster Management and Environment - Alka Chauhan
2. Climate Change, Extreme Events and Disaster Risk Reduction: Towards Sustainable Development Goals (Sustainable Development Goals Series)- Springer
3. Handbook on Climate Change and Disasters- Edited by Rajib Shaw

Fall Semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 439 : Environmental Impact Assessment and Sustainability	Lecture contact hours Credit hours	: 2.00 : 2.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The course provides an overview of the concepts, methods, issues and various forms and stages of the EIA process. This course also introduces the methodology of social impact assessment, In this course, students will also be introduced with the concept of sustainability and the corresponding methods of sustainable management of any project.			
OBJECTIVE			
• To understand importance of sustainability, major principles and different steps within environmental impact assessment. • To gain familiarity about social impact assessment and its corresponding objectives and methods in any projects • To apply concept of sustainability and environmental monitoring/management plan to manage social conflicts and reduce environment degradation of any projects			
COURSE CONTENT			
Important terms, aims, objectives, roles and methodology of environmental impact assessment; EIA of development schemes; Economical evaluation of EIA; EIA in water resources and industrial projects; Application of EIA; EIA for protection measures; EIA of : draughts in dry season, rainy season, impact of flood, solid waste management etc. Different EIA index calculation. Social impact assessment (SIA): terms, objectives, social variables and indicators, steps, methodologies, importance. Sustainability, SDG, Methods of Sustainable management.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

1	Ability to **understand** the roles and methodologies of environmental impact assessment, social impact assessment and sustainable management of resources.	√											
2	Ability to **interpret** an EIA or SIA through presenting the conclusions and translating the conclusions into actions.						√						
3	Ability to **apply** appropriate methods for sustainable management of resources, EIA or SIA depending on the criteria of the situation.					√		√					

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	Ability to **understand** the roles and methodologies of environmental impact assessment, social impact assessment and sustainable management of resources.	1	C2	1	--	1,3	Class Test, Mid-term, Pop quiz, Final Exam
CO2	Ability to **interpret** an EIA or SIA through presenting the conclusions and translating the	6	C3	1,2	--	7	Class Test, Mid-term, Pop quiz, Final Exam

	conclusions into actions.						
CO3	Ability to **apply** appropriate methods for sustainable management of resources, EIA or SIA depending on the criteria of the situation.	5, 7	C3	1,3	--	6,7	Assignment, Pop quiz

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	22 15
Assessment Continuous Assessment Final examination	2 3
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE			
Week	**Lectures**	**Topics**	**Assessments**
1	1	Environmental Issues in Bangladesh and environmental management	CT/ Assignment-1, Final Exam
	2	Overview of Policies, laws and Regulatory framework for environmental management in Bangladesh	
2	3	Guidelines and standards for environmental management in Bangladesh	
	4	EIA as a planning tool	
3	5	Steps in EIA process; how to conduct baseline studies	
	6	How to conduct baseline studies in EIA	
4	7	EIA methodologies: impact evaluation	
	8	EIA methodologies: significance of impacts	
5	9	Overview of modelling tools to assess impacts on environment	
	10	Sectoral EIA guidelines	
6	11	Economical evaluation of EIA	Mid Term/ Assignment-2, Final Exam
	12	Evaluation of EIA system in Bangladesh	
7	13	EIA in water resources and industrial projects	
	14	Application of EIA	
8	15	EIA for protection measures	
	16	Case Study for EIA: droughts in different seasons, impact of flood, solid waste management etc	
9	17	Case Study for EIA: droughts in different seasons, impact of flood, solid waste management etc	
	18	Different EIA index calculation	
10	19	Introduction to social impact assessment (SIA)	
	20	Social variables and indicators for SIA	
11	21	Steps in SIA process	
	22	SIA methodologies and importance	
12	23	SIA methodologies and importance	CT/ Assignment-3, Final Exam
	24	Introduction to Sustainability	
13	25	Discussion on SDG	

	26	Discussion on SDG	
14	27	Methods of Sustainable management	
	28	Review Class	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3	C2, C3
Final Exam	60%	CO1	C2
		CO2	C3
		CO3	C3
Total Marks	100%		

REFERENCE BOOKS

1. Methods of Environmental and Social Impact Assessment (Natural and Built Environment Series) – Riki Therivel and Graham Wood (4th Edition)
2. Environmental Assessment in Practice (Routledge Environmental Management) - Owen Harrop and Ashley Nixon
3. The Age of Sustainable Development - Jeffrey D Sachs and Ki–moon Ban

Fall Semester L-4, T-II

Sessional (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 432 : Design of Water Supply, Sanitation and Sewerage Systems	Lecture contact hours Credit hours	: 3.00 : 1.50
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This is a design course of water supply and sewerage system: estimation of industrial, domestic and fire demands, designing deep tubewell and water distribution network; estimation of industrial, domestic and commercial wastewater generation, wastewater network design. Students will be able to learn design of water/wastewater network using different software, household plumbing system design; design of water and wastewater treatment plant; computer application in environmental engineering; field visits and reporting, which will be useful in various professional project designing.			
OBJECTIVE			
• To develop a deep understanding of water supply and sewerage system • To be able to design deep tubewell and distribution network. • To be familiar with different design software. • To design water and wastewater treatment plant.			
COURSE CONTENT			
Design of water supply and sewerage system: estimation of industrial, domestic and fire demands, designing deep tubewell and water distribution network; estimation of industrial, domestic and commercial wastewater generation, wastewater network design; design of water/wastewater network using different software; household plumbing system design; design of water and wastewater treatment plant; computer application in environmental engineering; field visits and reporting.			

COURSE OUTCOMES AND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

1	**Use** techniques and modern tools in designing industrial waste treatment options for Engineering practice					√							
2	D**evelop** solutions for fresh water supply system, waste water discharge, storm water flow in urban as well as rural areas			√									

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	**Use** techniques and modern tools in designing industrial waste treatment options for Engineering practice	5	C3	1	-	6	Quiz + Viva
CO2	**Develop** solutions for fresh water supply system, waste water discharge, storm water flow in urban as well as rural areas	3	C5	1,3	-	5	Quiz + Viva

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity **Bloom's Taxonomy Levels**: **C1**: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 9 weeks)	27
Guided Learning Report Writing (1 hour/week x 9 weeks)	9
Independent Learning Individual learning Preparation for tests and examination Site Visit and Groupwork (3 hours/week x 2 weeks)	 06 06 06
Assessment Quiz+Viva	 06
Total	60

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Learning (PBL)

TEACHING SCHEDULE

Weeks	Lectures	Lecture/Tutorial/Assignment Topic	Assessment
1	1	Introduction, Organogram, Layout of Industrial Village: The Residential Zone, The Commercial Zone The Industrial Zone , The Administrative Zone	**Quiz-1, Viva, Lab Report**
2	2	Estimation Population & Water demand	
3	3	Design of Water Source	
4	4	Design of Water Source (Contd.)	
5	5	Pump Capacity and Pump Schedule	
6		Quiz 1 & Viva	
7	6	Water Distribution Network (Branch and Loop): Introduction Design of Branch Network for Residential and Commercial Zones	**Quiz-1, Viva, Lab Report**
8	7	Design of Loop Network for Industrial Zone	
9	8	Sanitary Sewer Design	

10	9	Sanitary Sewer Design (Contd.)		
11	10	Plumbing System		
12	11	Drainage System		
13	12	Software Introduction/ Report Submission		
14		Quiz 2 & Viva		

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous assessment and Quizes	55%	CO1, CO2	C3, C5
Report writing	35%	CO1	C3
		CO2	C5
Viva	10%	CO1, CO2	C3, C5
Total Marks	100%		

REFERENCE BOOKS

1. Waste Water Engineering - Metcaf & Eddy (4th edition)
2. Environmental Engineering - H.S. Peavy, D.R. Rowe, G. Tchobanoglous.
3. Harvesting Rainwater from Buildings - Syed Azizul Haque

7.5 Water Resource Engineering

Fall semester L-3, T-II

Theoretical (Core)

COURSE INFORMATION

Course Code	: CE 361	Contact hours	: 3.00
Course Title	: Open Channel Hydraulics	Credit hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course will be helpful for students to learn how to analyze different parameters of the Open channel flow and its classification; velocity and pressure distributions; energy equation, specific energy and transition problems; critical flow and control. In this course, students will also be introduced with the concept of uniform flow, Chezy and Manning equations, estimation of resistance coefficients and computation of uniform flow; momentum equation and specific momentum; hydraulic jump theory and analysis of gradually varied flow; computation of flow profiles; design of channels etc. These knowledges can be utilized in designing open channels i.e. drainage channels or irrigation canals etc.

OBJECTIVE

- To learn the energy and momentum theories for flow through open channels
- To understand the Manning's and Chezy's equation in designing open channels
- To estimate energy dissipation due to hydraulic jumps in open flows
- To design different type of channels and compute numerically the flow profiles

COURSE CONTENT

Open channel flow and its classification; velocity and pressure distributions; energy equation, specific energy and transition problems; critical flow and control; concept of uniform flow, Chezy and Manning equations, estimation of resistance coefficients and computation of uniform flow; momentum equation and specific momentum; hydraulic jump theory and analysis of gradually varied flow; computation of flow profiles; design of channels

COURSE OUTCOMESAND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Able to **apply** continuity equation, momentum equation, energy equation and concept of critical flow on open channel		√										

	system and solve real life problems.												
2	Able to **apply** the theories of uniform flow and measurement of channel parameters for different types of open channel flow.		√										
3	Able to **analyze** gradually and rapidly varied flow, and also compute numerically the flow profiles.		√										
4	Able to **design** rigid-boundary and erodible channels.			√									

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	Able to **apply** continuity equation, momentum equation, energy equation and concept of critical flow on open channel system and solve real life problems.	2	C2	1, 3		1, 2	Pop Quiz, Final Exam
CO2	Able to **apply** the theories of uniform flow and measurement of channel parameters for different types of open channel flow.	2	C3	1, 3		2, 3	Mid-Term, Final Exam
CO3	Able to **analyze** gradually and rapidly varied flow, and also compute numerically the flow profiles.	2	C3	1, 3		2, 3	Mid-Term, Final Exam

CO4	Able to **design** rigid-boundary and erodible channels.	3	C3	1, 2		4	Class Test, Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	42
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	15
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 36 22
Assessment Continuous Assessment Final examination	 2 3
Total	120

TEACHING METHODOLOGY

Lecture, Tutorial and Problem Based Learning

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Basic concepts of Open Channel Flow	CT/ Assignment-1
	2	Characteristics of open channel flow	
	3	Effect of gravity and viscosity on flow	
2	4	Velocity and pressure distribution	
	5	Correction factors for velocity and momentum	

	6	Continuity and Energy equation	
3	7	Concept of Specific energy, specific energy curve	
	8	Transition problem	
	9	Concept of Critical flow	
4	10	Theories related to critical flow	CT/ Assignment-2
	11	Computation of critical depths: analytical method	
	12	Computation of critical depths: trial and error method	
5	13	Concept of uniform flow	
	14	Uniform flow formulas	
	15	Chezy's and Manning's equation	
6	16	Resistance coefficients	Mid Term/ Assignment-3
	17	Computation of normal depth	
	18	Uniform flow for complex channels	
7	19	Hydraulic exponent for uniform flow computation	
	20	Computation of normal and critical slopes	
	21	Channel sections with composite roughness	
8	22	Compound Cross-sections	
	23	Principles of flow measurement and devices	
	24	Gradually Varied Flow (GVF): definition	
9	25	Dynamic equations of GVF, channel slopes	
	26	Flow profiles on Mild and Steep slopes	
	27	Flow profiles on Critical, Horizontal and Adverse slopes	
10	28	Draw simple profiles	
	29	Practice complex profiles	
	30	Calculation of critical and uniform depths	
11	31	Calculation of simple flow profiles	
	32	Description of Direct Step method	
	33	Numerical computation of flow profiles using direct step method	
12	34	Hydraulic Jump: definition, practical use, types etc	CT/ Assignment-4
	35	Hydraulic Jump: derivation of different theories	
	36	Hydraulic Jump: computation of jumps and losses of energies	

13	37	Design of Channels: basics, definition, design of simple channels	
	38	Design of best hydraulic sections	
	39	Design of erodible channels (theory)	
14	40	Design examples of erodible channels	
	41	Design of Alluvial channels: theory	
	42	Design examples of Alluvial channels	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3, CO4	C2, C3
Final Exam	60%	CO 1	C2, C3
		CO 2	C2, C3
		CO 3	C2, C3
		CO 4	C3
Total Marks	100%		

REFERENCE BOOKS

1. Open Channel Hydraulics by V T Chow
2. Open Channel Hydraulics by R H French
3. Flow Through Open channels by Rang Raju
4. Flow in Open Channel by K Subramanya
5. The Hydraulics of Open Channel Flows by Chanson H

Fall Semester L-3, T-II

Sessional (Core)

COURSE INFORMATION			
Course Code Course Title	: CE 362 : Open Channel Hydraulics Sessional	Contact hours Credit hours	: 3.00 : 1.50

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
It is a sessional course where students can have a hand on experiment about the state of flow; flow over a broad crested weir; flow through a venturi flume; flow through a parshall flume; flow beneath a sluice gate; study on hydraulic jump; specific energy and specific force curves; discharge and mean velocity of an open channel; change in water surface due to raised channel bottom etc. which will be useful in understanding behavior of flow through open channels.

OBJECTIVE

- To learn the state of flow while passing through open channels with velocity and discharge variation
- To devise the flow profiles and losses of energy when open channel flows passing through different hydraulic structures i.e. weir, sluice gate etc
- To apply the theories of energy and forces on open channel flows
- To learn basics about numerical modelling of 1D and 2D flows through open channels

COURSE CONTENT
Broad-crested weir; sluice gate; venturi flume; parshall flume; cutthroat flume; hydraulic jump; velocity distribution profile; Manning's roughness coefficient; specific force and specific energy; Hydraulic Modeling: basic principles of modeling 1D and 2D river flow, build a 1D or 2D flow model and interpret results.

COURSE OUTCOMESAND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the state of flow while passing through open channels with velocity and discharge variation.	√											

2	**Devise** the flow profiles and losses of energy when open channel flows passing through different hydraulic structures i.e. weir, sluice gate etc.		√										
3	**Apply** the theories of energy and force on open channel flows.		√										
4	**Understand** the basics about numerical modelling of 1D and 2D flows through open channels					√							

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom’ s Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the state of flow while passing through open channels with velocity and discharge variation.	1	C2		1	5	Lab Report + Quiz+ Viva
CO2	**Devise** the flow profiles and losses of energy when open channel flows passing through different hydraulic structures i.e. weir, sluice gate etc.	2	C3		1	6	Lab Report + Quiz + Viva
CO3	**Apply** the theories of energy and force on open channel flows	2	C3		1	3	Lab Report + Quiz + Viva
CO4	**Understand** the basics about numerical modelling of 1D and	5	C2		3	6	Class Work, Open Ended Lab

	2D flows through open channels						

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 10 weeks)	30
Guided Learning Report Writing (1 hour/week x 9 weeks)	01
Independent Learning Individual learning	10 08
Assessment Quiz +Viva	2
Total	60

TEACHING METHODOLOGY

Lecture and Experiments, Software applications

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Introduction	Lab Manual, Lecture notes, Reference texts etc.
2	2	Determination of State of Flow and Critical Depth in Open Channel	
3	3	Flow over Broad Crested Weir	
4	4	Flow through a Venturi Flume	
5	5	Flow through a Parshall Flume	
6	6	Flow beneath a Sluice Gate	

7	7	Mid Quiz	
8	8	Study on Hydraulic Jump	
9	9	Development and Generalized Specific Energy and Specific Force Curves	
10	10	Determination Discharge and Mean Velocity of an Open Channel	
11	11	Determination of Change in Water Level due to Raised Channel Bottom	
12	12	Development of 1D and 2D River flow model	
13	13	Development of 1D and 2D River flow model	
14	14	Final Quiz + Viva	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Conduct Lab Test & Lab Report)	40%	CO1, CO2, CO3	C2, C3
Quiz & Viva	60%	CO 1	C2
		CO 2	C3
		CO 3	C3
		CO4	C3
Total Marks	100%		

REFERENCE BOOKS

1. Open Channel Hydraulics Sessional Lab Manual
2. Open Channel Flow by V.T. Chow

Spring Semester L-4, T-I

Theoretical (Core)

<table>
<tr><th colspan="4">COURSE INFORMATION</th></tr>
<tr><td>Course Code
Course Title</td><td>: CE 463
: Hydrology and Irrigation Engineering</td><td>Contact hours
Credit hours</td><td>: 4.00
: 4.00</td></tr>
<tr><th colspan="4">PRE-REQUISITE</th></tr>
<tr><td colspan="4">None</td></tr>
<tr><th colspan="4">CURRICULUM STRUCTURE</th></tr>
<tr><td colspan="4">Outcome Based Education (OBE)</td></tr>
<tr><th colspan="4">SYNOPSIS/RATIONALE</th></tr>
<tr><td colspan="4">This course will be helpful for students to learn about Hydrologic cycle; Weather and hydrology; Precipitation, Evapo-transpiration; Infiltration; Stream flow; Application of telemetry and remote sensing in hydrologic data acquisition; Rainfall-runoff relations; Hydrographs, unit hydrographs; Hydrologic routing; Statistical methods in hydrology etc. In this course, students will also be introduced with the concept of Plant-soil-water relationship; Consumptive use and estimation of irrigation water requirements; Design of irrigation canal system; Methods of irrigation; quality of irrigation water; problems of irrigated land etc. which will be useful in handling various projects in their professional life.</td></tr>
<tr><th colspan="4">OBJECTIVE</th></tr>
<tr><td colspan="4">• To learn basic concepts of hydrology, various process, measurement and estimation of hydrological components: precipitation, evaporation, stream flow etc
• To understand rainfall-runoff relationship, hydrographs and apply various statistical methods for hydrological analysis
• To understand the basic requirements of irrigation and various irrigation techniques, crop water requirements etc
• To design different irrigation canals required for a project with other hydraulic structures</td></tr>
<tr><th colspan="4">COURSE CONTENT</th></tr>
<tr><td colspan="4">Hydrologic cycle; Weather and hydrology; Precipitation, evaporation and transpiration; Infiltration; Stream flow; Application of telemetry and remote sensing in hydrologic data acquisition; Rainfall-runoff relations; Hydrographs, unit hydrographs; Hydrologic routing; Statistical methods in hydrology; Plant-soil-water relationship; Consumptive use and estimation of irrigation water requirements; Design of irrigation canal system; Methods of irrigation; quality of irrigation water; problems of irrigated land.</td></tr>
</table>

<table>
<tr><th colspan="14">COURSE OUTCOMESAND SKILL MAPPING</th></tr>
<tr><td rowspan="2">No.</td><td rowspan="2">COURSE OUTCOMES (COs)</td><td colspan="12">PROGRAMME OUTCOMES (POs)</td></tr>
<tr><td>PO1</td><td>PO2</td><td>PO3</td><td>PO4</td><td>PO5</td><td>PO6</td><td>PO7</td><td>PO8</td><td>PO9</td><td>PO10</td><td>PO11</td><td>PO12</td></tr>
<tr><td>1</td><td>Describe the basic concepts of hydrology, various process, measurement and estimation of</td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

	hydrological components: precipitation, evaporation, stream flow etc.												
2	**Develop** rainfall-runoff relationship, hydrographs and apply various statistical methods for hydrological analysis		√										
3	**Understand** the basic requirements of irrigation and various irrigation techniques, crop water requirements etc	√											
4	**Design** different irrigation canals required for a project with other hydraulic structures			√									

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Describe** the basic concepts of hydrology, various process, measurement and estimation of hydrological components: precipitation, evaporation, stream flow etc.	1	C2	1, 3		1	Pop Quiz, Final Exam
CO2	**Develop** rainfall-runoff relationship, hydrographs and apply various statistical methods for hydrological analysis	2	C4	1, 3		2, 3	Mid-Term, Final Exam
CO3	**Understand** the basic requirements of irrigation and various irrigation techniques, crop water requirements etc	1	C2	1, 6		1, 4	Mid-Term, Final Exam
CO4	**Design** different irrigation canals required for a project with other hydraulic structures	3	C3	1, 3		4	Class Test, Final Exam

Knowledge Profile (K): **K1**: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature **Complex Engineering Problem (P)**: **P1**: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence **Complex Engineering Activities (A)**: **A1**: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity **Bloom's Taxonomy Levels**: **C1**: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 14 weeks)	56
Guided Learning Tutorial/ Assignments (3 hours/week x 5 weeks)	14
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	48 36
Assessment Continuous Assessment Final examination	3 3
Total	160

TEACHING METHODOLOGY

Lecture and Tutorial, Problem Based Learning

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Introduction: Hydrological Cycle, Catchment Area	CT/ Assignment
	2	Introduction: Water Budget Equation, Residence Time	
	3	Weather System: Temperature and Pressure variation in the atmosphere; Weather parameter estimation	
2	4	Weather System: Precipitable water in the air column	
	5	Precipitation: Formation of precipitation, Forms of precipitation	

	6	Precipitation: Measurement of precipitation, Computation of average rainfall, Analysis of Rainfall Data	
3	7	Precipitation: Analysis of Rainfall Data; Presentation of Rainfall Data	
	8	Evaporation: Evaporation process, Estimation of evaporation	
	9	Evaporation: Transpiration and Evapo-transpiration, Estimation of Potential Evapo-transpiration	
4	10	Runoff: Components of runoff; Stream characteristics; Yield of a river, Rainfall & Runoff correlation	CT/ Assignment
	11	Runoff: Flow-Duration curve; Drought: Occurrence, Classification and Management	
	12	Stream Flow Measurement: Stream; Stream Flow and its measurement; Stage of a river and its measurement; Measurement of Discharge by Area-Velocity method	
5	13	Stream Flow Measurement: Shifting and Permanent Control; Stage (G)-Discharge (Q) Relationship; Extrapolation of rating curve	
	14	Infiltration: Infiltration and Infiltration Capacity, Horton's equation for Infiltration Capacity	
	15	Infiltration: Horton's equation for Infiltration Capacity, Infiltration Index	
6	16	Infiltration: Infiltration Index	Mid Term/ Assignment
	17	Flood: Flood and Peak Flood, Estimating magnitude of peak flood: Rational Method	
	18	Flood: Flood frequency analysis for estimating peak flood	
7	19	Flood: Risk and safety factor	
	20	Hydrograph: Storm Hydrograph and its component; Factors affecting flood/storm hydrograph	
	21	Hydrograph: Base flow separation technique for measuring Direct Runoff Hydrograph (DRH)	
8	22	Irrigation: definition, importance, advantages and ill-effects	
	23	Methods of irrigation: surface method	
	24	Methods of irrigation: furrow, sprinkler and drip method	
9	25	Development of an irrigation project	
	26	Sources and Quality of irrigation water	

	27	Quality related problems	
10	28	Effective rainfall and irrigation efficiencies	
	29	Estimation of crop water requirement	
	30	Irrigation scheduling	
11	31	Delta and duty	
	32	Calculation of available water and scheduling	
	33	Soil-water relationship	
12	34	Measurement techniques of soil moisture	CT/ Assignment
	35	Systems of irrigation canals	
	36	Components of an irrigation canal	
13	37	Physical and economic justification of canals	
	38	Design parameters of irrigation canals	
	39	Design of lined and unlined canals	
14	40	Design of alluvial canals	
	41	Diversion head works	
	42	Diversion head works	

ASSESSMENT STRATEGY

Components	Grading	CO	Blooms Taxonomy
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2, CO3, CO4	C2, C3, C4
Final Exam	60%	CO 1	C2
		CO 2	C4
		CO 3	C2
		CO 4	C3
Total Marks	100%		

REFERENCE BOOKS

1. Irrigation Principles and Practices by Vaughn, E. Hansen, Orson W. Israelsen
2. Applied Hydrology by V T Chow, David R Maidment
3. Irrigation Engineering and Hydraulic Structures by Garg
4. Introductory Irrigation Engineering by B. C. Punmia
5. Engineering Hydrology by Subramanya

Fall Semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 465 : Groundwater Engineering	Contact hours Credit hours	: 2.00 : 2.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
In this course students will beable to learn the basic of groundwater in hydrologic cycle and its occurrence; physical properties and principles of groundwater movement; groundwater and well hydraulics; groundwater resource evaluation; groundwater level sand environmental influences; water mining and land subsidence. Through this course, they will gain the expertise on groundwater pollution and contaminant transport; recharge of groundwater; saline water intrusion in aquifers; groundwater management which will enhance their skills in proper using of groundwater in drinking or irrigation purposes.			
OBJECTIVE			
• To understand the basics of ground water, their physical properties and principles of groundwater movement • To understand and apply knowledge regarding groundwater resource evaluation, contaminant transport; recharge of groundwater; saline water intrusion in aquifers; groundwater management etc			
COURSE CONTENT			
Groundwater in hydrologic cycle and its occurrence; Physical properties and principles of groundwater movement; Groundwater and well hydraulics; Groundwater resource evaluation; Groundwater levels and environmental influences; Water mining and land subsidence; Groundwater pollution and contaminant transport; Recharge of groundwater; Saline water intrusion in aquifers; Groundwater management.			

COURSE OUTCOMESAND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the basics of groundwater; physical properties and principles of groundwater movement; well hydraulics	√	√										

2	**Apply** knowledge regarding groundwater resource evaluation, contaminant transport; recharge of groundwater; saline water intrusion in aquifers; groundwater management		√	√									

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the basics of groundwater; physical properties and principles of groundwater movement; well hydraulics	1, 2	C2	1, 3		5	CT/ Assignment/ Final Exam
CO2	**Apply** knowledge regarding groundwater resource evaluation, contaminant transport; recharge of groundwater; saline water intrusion in aquifers; groundwater management	2, 3	C3	1, 3		3, 5	Mid Term/ Assignment/ Final Exam

<u>Knowledge Profile (K)</u>:

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

<u>Complex Engineering Problem (P)</u>:

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

<u>Complex Engineering Activities (A)</u>:

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

<u>Bloom's Taxonomy Levels</u>:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 22 15
Assessment Continuous Assessment Final examination	 2 3
Total	80

TEACHING METHODOLOGY
Lecture and Tutorials, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Introduction to Groundwater Engineering	CT/ Assignment/ Final Exam
	2	Groundwater in hydrologic cycle and its occurrence	
2	3	Groundwater in hydrologic cycle and its occurrence	
	4	Physical properties of groundwater movement	
3	5	Physical properties of groundwater movement	
	6	Principles of groundwater movement	
4	7	Principles of groundwater movement	
	8	Principles of groundwater movement	
5	9	Groundwater and well hydraulics	
	10	Groundwater and well hydraulics	
6	11	Groundwater and well hydraulics	Mid Term/ Assignment/ Final Exam
	12	Groundwater resource evaluation	
7	13	Groundwater resource evaluation	
	14	Groundwater level sand environmental influences	
8	15	Groundwater level sand environmental influences	
	16	Groundwater level sand environmental influences	
9	17	Water mining and land subsidence	
	18	Water mining and land subsidence	
10	19	Groundwater pollution and contaminant transport	
	20	Groundwater pollution and contaminant transport	
11	21	Groundwater pollution and contaminant transport	
	22	Recharge of groundwater	

12	23	Recharge of groundwater	CT/ Assignment/ Final Exam
	24	Saline water intrusion inaquifers	
13	25	Saline water intrusion in aquifers	
	26	Groundwater management	
14	27	Groundwater management	
	28	Review Class	

ASSESSMENT STRATEGY

Components	Grading	CO	Blooms Taxonomy
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2	C2, C3
Final Exam	60%	CO1	C2
		CO2	C3
Total Marks	100%	CO1, CO2	C2, C3

REFERENCE BOOKS

1. Groundwater Engineering by Toad
2. Groundwater Hydrology by Rushton
3. Fundamentals of Ground Water by Schwartz
4. Hydraulics of Groundwater by Jacob Bear

Fall Semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 467 : Flood Mitigation and Management	Contact hours Credit hours	: 2.00 : 2.00

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
In this course students will be able to learn the basic of Flood and its causes; management of flood water, structural and non-structural measures to mitigate flood damage. The course will provide essential skillsets required in their professional life as Flooding is a regular phenomenon in Bangladesh.

OBJECTIVE

- To understand the basics of flood and its causes; structural and non-structural methods of flood management
- To understand the economic aspects of flood management including flood risk and vulnerability analysis, direct and indirect losses of flood, flood damage assessment etc

COURSE CONTENT
Flood and its causes; methods of flood management: structural and non-structural measures such as reservoirs, levees and flood walls, channel improvement, interior drainage, flood ways, land management, flood proofing, flood zoning, flood hazard mapping, flood forecasting and warning. Economic aspects of flood management: flood risk and vulnerability analysis, direct and indirect losses of flood, flood damage assessment, flood damage in urban and rural areas.

COURSE OUTCOMESAND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the basics of flood and its causes; structural and non-structural methods of flood management	√											
2	**Apply** the economic aspects of flood management including flood risk and vulnerability analysis, direct and indirect losses of flood, flood damage assessment, flood		√										

	damage in urban and rural areas.												

Program Outcomes (PO):

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the basics of flood and its causes; structural and non-structural methods of flood management	1	C2			5	CT/ Assignment/ Final Exam
CO2	**Apply** the economic aspects of flood management including flood risk and vulnerability analysis, direct and indirect losses of flood, flood damage assessment, flood damage in urban and rural areas	2	C3			3, 5	Mid Term/ Assignment/ Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks)	28

Guided Learning Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 22 15
Assessment Continuous Assessment Final examination	 2 3
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Tutorials

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Introduction to Flood Mitigation and Management	CT/ Assignment
	2	Types of flood and its causes	
2	3	Types of flood and its causes	
	4	Structural methods of flood management: reservoirs	
3	5	Structural methods of flood management: levees	
	6	Structural methods of flood management: embankment	
4	7	Structural methods of flood management: flood walls	
	8	Structural methods of flood management: flood bypass	
5	9	Non-Structural methods of flood management: land management	
	10	Non-Structural methods of flood management: flood proofing	
6	11	Non-Structural methods of flood management: flood zoning	Mid Term/ Assignment
	12	Non-Structural methods of flood management: flood hazard mapping	
7	13	Non-Structural methods of flood management: flood forecasting	
	14	Non-Structural methods of flood management: early warning system	
8	15	Functions and ecology of river-floodplain system	
	16	Functions and ecology of river-floodplain system	
9	17	Functions and ecology of river-floodplain system	
	18	Flood risk and vulnerability analysis	
10	19	Flood risk and vulnerability analysis	
	20	Flood risk and vulnerability analysis	

11	21	Flood forecasting	
	22	Economic aspects of flood management: direct losses of flood	
12	23	Economic aspects of flood management: indirect losses of flood	CT/ Assignment
	24	Flood damage assessment	
13	25	Flood damage assessment	
	26	Flood damage in urban and rural area	
14	27	Flood damage in urban and rural area	
	28	Review Class	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Assignments/CT/Mid Term)	40%	CO1, CO2	C2, C3
Final Exam	60%	CO1	C2
		CO2	C3
Total Marks	100%	CO1, CO2	C2, C3

REFERENCE BOOKS

1. Flood Control and Drainage Engineering by Ghosh
2. Principles of Water Resources Planning by Dr. Aynon Nishat

Fall semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 469 : River Engineering	Contact hours Credit hours	: 2.00 : 2.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
In this course students will be able to learn the basic of river engineering and the morphological processes related to river. After this course they will become skilled at the design and construction of different types of small structures such as Groyne, Guide bund etc. which will enhance their skills of designing hydraulic structures in professional life.			
OBJECTIVE			
• To gain knowledge on the basics of river engineering, morphology, scouring and the aggradation-degradation processes • To gain the basic knowledge on river training work and be able to design different types of structures such as groyne, guide bund etc			
COURSE CONTENT			
Behaviour of alluvial rivers; river channel pattern and fluvial processes; aggradations and degradation, local scours; river training and bank protection works; navigation and dredging; sediment movement in river channels, bed form and flow regimes; Application of mathematical models for river problems.			

COURSE OUTCOMESAND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the basics of river engineering, morphology, scouring and the aggradation-degradation process.	√											
2	**Apply** the understanding of basic knowledge on river training work and **design** of river training works.		√	√									

Program Outcomes (PO):							
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning							
COURSE OUTCOMES AND GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the basics of river engineering, morphology, scouring and the aggradation-degradation process.	1	C2			5	CT/ Assignment/ Final Exam
CO2	**Apply** the understanding of basic knowledge on river training work and **design** of river training works.	2, 3	C3	1, 7		3, 5	Mid Term/ Assignment/ Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 22 15

Assessment Continuous Assessment Final examination	 2 3
Total	80

TEACHING METHODOLOGY
Lecture and Discussion, Problem Based Learning

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Introduction to River Engineering	CT/ Assignment/ Final Exam
	2	Classification of rivers Basic river parameters Meandering processes and its parameters Development of Oxbow lake	
2	3	Basic river channel pattern Agents and processes that shape the earth surface River system and parts of a river system Stream patterns on landform	
	4	Introduction to river morphology Fluvial processes Impact of fluvial processes on landscape Some basic stream pattern	
3	5	Classification of erosion Valley and interfluve The shaping and reshaping of valleys and interfluves	
	6	Introduction to floodplain Stream rejuvenation Formation of landforms	
4	7	Introduction to River training works Objective of river training works	
	8	Classification of different river training works Brief on the types of river training works	
5	9	Groyne, Guide bank, Levees, Embankment Typical layout of river training works Classification of guide bund Design considerations of a guide bund	
	10	Typical design of a guide bund.	
6	11	Groyne, Objectives of Groyne, Types of Groyne Suitability of Groyne and its applicability in the river training work Description of different types of Groyne	Mid Term/ Assignment/ Final Exam
	12	Introduction to levees or marginal bund Design consideration of levees Causes of failure of a levee	

7	13	Advantages and disadvantages of river training by embankment Suitability of different hydraulic structure in Bangladesh	
	14	Different types of bank protection work Purpose of bank protection	
8	15	Applicability of Sheet pile, Riprap, Gabions and Falling Apron	
	16	Introduction to navigation and dredging Various requirements of a navigable waterway Brief on various measures on achieving navigability Description of open channel method	
9	17	Importance of contraction works in the river training works Lock and Dam arrangement in a river Different types of dam, barrages and weirs	
	18	Introduction to different temporary river improvement technique Details of bandaling system and its feasibility Surface panel system and its applicability	
10	19	Dredging and its classification Different types of dredgers used to achieve navigability Brief on bucket dredger, cutter dredger, dustpan dredger and hopper dredger.	
	20	Aggradation and degradation process in a river Lanes balance analogy	
11	21	Effects of aggradation and degradation in a river bed and banks	
	22	Effects of aggradation and degradation in a river bed and banks Measures to prevent the degradation process in a river. Occurrence of aggradation in a channel.	
12	23	Scouring and its classification. Differences between general scour, constriction scour and local scour Clear water scour and live bed scour, Local scour and its types Possible cases of local scour and local scour around a bridge pier	CT/ Assignment/ Final Exam
	24	Flow pattern around a cylindrical pier Formation of horseshoe vortex and cast-off vortices Scouring process around an abutment. Scouring due to the presence of hydraulic structure Some problems related to local scouring	

13	25	Sediment transport in a river channel A complete river system Types of sediment transport	
	26	Description of sediment load Sediment characteristics Brief on different sediment transport model	
14	27	Flood and its control River training to control flood River training to guide flow	
	28	Review Class	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2	C2, C3
Final Exam	60%	CO1	C2
		CO2	C3
Total Marks	100%	CO1, CO2	C2, C3

REFERENCE BOOKS

1. River Mechanics by P Y Julian
2. River Morphology by Garde
3. River Engineering by K D Gupta
4. Fluvial Processes in River by Howard H Chang
5. Principles of River Engineering by Chang

Fall semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code	: CE 471	Contact hours	: 2.00
Course Title	: Hydraulic Structure	Credit hours	: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

In this course students can learn about basic principles and analysis of both static and dynamic water loads, failure characteristics and operation of hydraulics structures. After this course they will be able to perform design calculations of different hydraulic structures which will enhance their skills of designing hydraulic structures in professional life.

OBJECTIVE

- Integrate the hydraulics and water resources background in water structures design applications
- Develop understanding of the basic principles and concepts of analysis and design of hydraulic structures
- Undertake basic design calculations of different hydraulic structures

COURSE CONTENT

Hydraulic structures – characteristics and types: Diversion head works; Principles of design hydraulic structures; Design of dams, barrages, weirs, spillways, energy dissipators; Cross drainage works, Reservoir.

COURSE OUTCOMESAND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the basic principles and analysis of both static and dynamic water loads, failure characteristics and operation of hydraulics structures.	√											
2	**Apply** understanding of the basic principles and concepts of analysis and design of hydraulic structures			√									

Program Outcomes (PO):							
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning							
COURSE OUTCOMES AND GENERIC SKILLS							
No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the basic principles and analysis of both static and dynamic water loads, failure characteristics and operation of hydraulics structures.	1	C2	1, 3		5	CT/ Assignment/ Final Exam
CO2	**Apply** understanding of the basic principles and concepts of analysis and design of hydraulic structures	3	C3	1, 7		3, 5	Mid Term/ Assignment/ Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (2 hours/week x 5 weeks)	10

Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 22 15
Assessment Continuous Assessment Final examination	 2 3
Total	80

TEACHING METHODOLOGY

Lecture and Tutorials, Design Projects, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Fundamentals of hydraulic structures	CT/ Assignment/ Final Exam
	2	Different types of Hydraulic Structures	
2	3	Failure of foundation, Seepage theory	
	4	Bligh's and Lane's Creep theory	
3	5	Khosla's theory	
	6	Examples based on Khosla's theory	
4	7	Weir: definition, types, design parameters	
	8	Design of a vertical drop weir	
5	9	Design details of weir foundation	
	10	Barrage: details design parameters	
6	11	Design of a modern barrage	Mid Term/ Assignment/ Final Exam
	12	Dam: classification, components, construction of dams	
7	13	Gravity dam, arch dam, buttress dam and embankment dam	
	14	Safety of a dam and rehabilitation	
8	15	Design of a Gravity Dam: Stability check	
	16	Design of a Gravity Dam: detail design	
9	17	Spillway: necessity, location and discharge capacity of spillways	
	18	Spillway: types, components, spillway gates	
10	19	Design of Ogee Spillway	
	20	River Training Works	
11	21	Guide Bank	

	22	Detail design of a guide bank	
12	23	Groynes, Cut-offs, Launching apron	CT/ Assignment/ Final Exam
	24	Cross drainage works	
13	25	Design of a cross drainage works	
	26	Reservoir: characteristics, capacity, sedimentation	
14	27	Energy dissipator, design of stilling basin	
	28	Review	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2	C2, C3
Final Exam	60%	CO1	C2
		CO2	C3
Total Marks	100%	CO1, CO2	C2, C3

REFERENCE BOOKS

1. Hydraulic Structures by Garg
2. Irrigation and Water Power Engineering by Punmia
3. Irrigation and Water Resources Engineering by Asawa
4. Theory and Design of Irrigation Structure by Varshney
5. Dam and Appurtenant Hydraulic Structure by Ljubomir Tanchew

Fall semester L-4, T-II

Theoretical (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 473 : Coastal Engineering	Contact hours Credit hours	: 2.00 : 2.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
In this course, students will be able to learn the basic of coast and coastal features; deltas and estuaries; tide; wave; storm surge; tsunami; port, dock and harbour; wave forces on coastal structures; coastal sedimentation processes. After this course they will become skilled at the design and construction of different types of shore protection works which will enhance their skills of designing coastal structures in professional life.			
OBJECTIVE			
• To understand characteristics of tides, theory behind tidal analysis and prediction, tidal flow measurement, • To understand and apply the principles of coastal processes, sediment transport, deltas and delta management plan, estuary and estuarine control, • To be skilled at fundamental concepts in designing shore protection works.			
COURSE CONTENT			
Coast and coastal features; deltas and estuaries; tide; wave; storm surge; tsunami; port, dock and harbour; wave forces on coastal structures; coastal sedimentation processes; shore protection works; design of shore protection structure.			

COURSE OUTCOMESAND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the basics of coastal processes ie waves, tides, sediment transport and able to calculate forces on coastal structures.	√											
2	**Apply** the understanding of basic knowledge to design shore protection work.			√									

Program Outcomes (PO): **PO1**: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning
COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the basics of coastal processes ie waves, tides, sediment transport and able to calculate forces on coastal structures.	1	C2			3	CT/ Assignment/ Final Exam
CO2	**Apply** the understanding of basic knowledge to design shore protection work.	3	C3	1, 3		3, 5	Mid Term/ Assignment/ Final Exam

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (2 hours/week x 14 weeks)	28
Guided Learning Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	 22 15

Assessment Continuous Assessment Final examination	 2 3
Total	80

TEACHING METHODOLOGY
Lecture and Discussion, Problem Based Learning (PBL)

TEACHING SCHEDULE

Week	Lectures	Topics	Assessments
1	1	Introduction to Coastal Engineering	CT/ Assignment/ Final Exam
	2	Tides and coastal processes: Terms and Definitions, Characteristics of tides, Tide chart	
2	3	Theory behind tidal analysis and prediction, Methods of tidal analysis and prediction	
	4	Harmonic analysis of water level and current data	
3	5	Definition of wave parameters, waves and its characteristics	
	6	Linear wave theory: wave celerity, length, and period, the sinusoidal wave profile	
4	7	Sediment transport	
	8	Sediment transport	
5	9	Deltas, deltaic coasts, delta morphologies	
	10	Storm surge, wind stress	
6	11	Tsunami: physical characteristics of tsunami, causes of tsunami	Mid Term/ Assignment/ Final Exam
	12	Tsunami: mitigation of risks and hazards, prediction and early warnings	
7	13	Hydrodynamics and Sediment Dynamics of Tidal Inlets	
	14	Coastal-Offshore Ecosystem	
8	15	Estuarine Sediment Dynamics	
	16	Estuarine Cohesive Sediment Dynamics	
9	17	Offshore and Coastal Modelling	
	18	Harbour layout: Types, port terms, site selection, features	
10	19	Harbour planning and Layout	
	20	Types and function of coastal structures	
11	21	Design of shore protection works	
	22	Design of shore protection works	
12	23	Functional design of coastal structures	CT/ Assignment/ Final Exam
	24	Design of coastal revetments	
13	25	Design of coastal sea walls	

	26	Design of coastal sea bulkheads	
14	27	Environmental impacts of coastal structures	
	28	Review Class	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Class assignments/ CT/ Mid Term/ Active Class Participation)	40%	CO1, CO2	C2, C3
Final Exam	60%	CO1	C2
		CO2	C3
Total Marks	100%	CO1, CO2	C2, C3

REFERENCE BOOKS

1. Basic Coastal Engineering by R M Sorensen
2. Sediment Control Handbook by Jackson
3. Sediment Transport Technology: Water and Sediment Dynamics by Daryl B Simons and Fuat Senturk
4. Coastal Engineering Manual by US Army Corps of Engineers (USACE)
5. Shore Protection Manual by US Army Coastal Engineering Research Center

Fall semester L-4, T-II

Sessional (Elective)

COURSE INFORMATION			
Course Code Course Title	: CE 472 : Hydraulic Structure Design Sessional	Contact hours Credit hours	: 3.00 : 1.50

PRE-REQUISITE
None
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
In this design sessional, students can know about design requirements as well as detail design (hydrologic, hydraulic, structural and foundation design) of a hydraulic structure which will be useful in their professional life.
OBJECTIVE
• To gain knowledge on the basics of hydrologic, hydraulic and structural design requirements and techniques. • To become skilled at the design and construction of different hydraulic structures.
COURSE CONTENT
Details design of a hydraulic structure: hydrologic, hydraulic, structural and foundation design of a drainage regulator.
COURSE OUTCOMESAND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**Understand** the basic requirements of hydrologic, hydraulic and structural design of a hydraulic structure.	√											
2	**Design** in details and **draw** cross-sections of different elements of a hydraulic structure.			√									

<u>Program Outcomes (PO)</u>:

PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**:

Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	**Understand** the basic requirements of hydrologic, hydraulic and structural design of a hydraulic structure.	1	C2	1	-	5	Lab Report + Quiz+ Viva
CO2	**Design** in details and **draw** cross-sections of different elements of a hydraulic structure.	3	C3	1, 7	-	3, 5	Lab Report + Quiz + Viva

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face to Face Learning Lecture (3 hours/week x 10 weeks)	30
Guided Learning Report Writing (1 hour/week x 9 weeks)	01
Independent Learning Individual learning	10 08
Assessment Quiz +Group Presentation	2

Total	60

TEACHING METHODOLOGY
Lecture and Discussion, Design Calculation, Drawing

TEACHING SCHEDULE			
Week	**Lectures**	**Topics**	**Assessments**
1	1	Introduction to hydraulic structure design and design requirements	Lab Manual, Lecture notes, Reference texts etc.
2	2	Development of 6-h Unit Hydrograph Computation of Runoff Hydrograph	
3	3	Development of stage-discharge curve Discharge (D) vs ($\frac{2S}{t} + D$) curve generation	
4	4	Flood Routing by Goodrich Method Determination of Glacis Height	
5	5	Design of stilling basin Computation of Cut-off Depth Determination of Floor Length and Stilling Basin Parameters	
6	6	Flow beneath a Sluice Gate	
7	7	Mid Quiz	
8	8	Determination of Floor Thickness & Exit Gradient Design of Launching Apron	
9	9	Total Load Calculation Determination of Factor of Safety	
10	10	Reinforcement Detailing of Top and Bottom Slab	
11	11	Design of Abutment and Pier	
12	12	Design of Retaining Wall	
13	13	Final Quiz + Group Presentation	

ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (Conduct Lab Test & Lab Report)	40%	CO1, CO2	C2, C3
	60%	CO 1	C2

Quiz &Group presentation		CO 2	C3
Total Marks	100%		
REFERENCE BOOKS			

1. Hydraulic Structures by S K Garg
2. Principles of Design of Drainage Sluice by Sunil Chandra

Project and Thesis

Level-4 Spring and Fall Semester

COURSE INFORMATION			
Course Code Course Title	: CE 400 : Project and Thesis	Contact hours Credit hours	: 2 hrs/week in 4/I and 6 hrs/week in 4/II : 4.00 credit
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The course will help students to understand the research process with the help of relevant literature review, experimentation, and in-depth investigation in structural engineering, environmental engineering, transportation engineering, geotechnical engineering, and water resource engineering. Students will develop critical thinking capacity and improve communication and analytical skills. Students will be able to create a proper engineering project work as per the engineering dissertation/ thesis format.			
OBJECTIVE			
• To acquire knowledge about the research process with the help of a relevant literature review • To solve a problem individually or as a team with guidance from the supervisor(s) through experiment and/or detail investigation			
COURSE CONTENT			
Experimental, numerical and/or theoretical investigation of various topics in structural engineering, environmental engineering, transportation engineering, geotechnical engineering, and water resource engineering. Individual or group study of one or more topics from any of the above fields. The students will be required to submit a thesis report at the end of the work and present his/her work in front of a board consists of faculty member(s).			

COURSE OUTCOMESAND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ability to compose the problem statements with research gap and objectives of the project/thesis		√										
2	Ability to conduct a literature review to develop research methodology using standard references, including conference		√										

	proceedings, journals, theses, books etc.												
3	Ability to communicate through proposal writing following standard format and performs verbal presentation										√		
4	Ability to conduct research experiments, analyze and interpret data and deduce conclusion based on knowledge in the broadest context				√								
5	Ability to conduct the study and write report without conflicting with the engineering and professional principles and ethics								√				
6	Ability to plan activities pertaining to research and execute the plan to meet the required objectives which indicates lifelong learning												√
7	Ability to write research report that conforms to standard thesis format and performs verbal presentation										√		

Program Outcomes (PO):
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom' s Taxonomy	P	A	K	Assessment Methods
CO1	Ability to compose the problem statements with research gap and objectives of the project/thesis	2	C1	1	-	8	Proposal Writing + Presentation

CO2	Ability to conduct a literature review to develop research methodology using standard references, including conference proceedings, journals, theses, books etc.	2	C2	1	3	8	Proposal Writing + Presentation
CO3	Ability to communicate through proposal writing following standard format and performs verbal presentation	10	C2	-	-	-	Proposal Writing + Presentation
CO4	Ability to conduct research experiments, analyze and interpret data and deduce conclusion based on knowledge in the broadest context	4	C6	1, 3	1, 3	3, 7	Report Writing + Presentation
CO5	Ability to conduct the study and write report without conflicting with the engineering and professional principles and ethics	8	C5	-	-	-	Plagiarism Software
CO6	Ability to plan activities pertaining to research and execute the plan to meet the required objectives which indicates lifelong learning	12	C5	-	-	-	Report Writing + Presentation
CO7	Ability to write research report that conforms to standard thesis format and performs verbal presentation	10	C2	-	-	7	Report Writing + Presentation

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create	
TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning 2 hrs/week in 4/I and 6 hrs/week in 4/II	40
Guided Learning Experimentation/Modeling	100
Independent Learning Individual learning Preparation for Viva and presentation	 14 3
Assessment Proposal Thesis Presentation	0.5 1.5 1
Total	160
TEACHING METHODOLOGY	
Analytical/ Experimental/ Modeling	
TEACHING SCHEDULE	
Guided by a Supervisor CO1 – CO3: in 4/I and CO4 – CO7: in 4/II	

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Blooms Taxonomy**
Proposal Writing with Presentation	20%	CO1, CO2, CO3	C1, C2
Thesis Writing	35%	CO4, CO6, CO7	C5, C6,
Thesis Presentation	25%	CO4, CO6, CO7	C5, C6
Ethics	10%	CO5	C5
LLL	10%	CO6	C5
Total Marks	100%		

Capstone Project

Level-4 Spring and Fall Semester

COURSE INFORMATION			
Course Code Course Title	: CE 450 : Capstone Project	Contact hours Credit hours	: 2 hrs/week in 4/I and 4 hrs/week in 4/II : 3.00 credit
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Planning, analysis, and design of an integrated civil engineering project with emphasis on structural engineering/ environmental engineering/ transportation engineering/ geotechnical engineering/ water resources engineering specialization. Students shall work in teams to apply civil engineering aspects to assess the technical, environmental, and social feasibility of the project including design and cost estimation. Students shall present and submit reports at different stages of the project work.			
OBJECTIVE			
• To acquire knowledge about an integrated design project considering health and safety, society and culture, environment and sustainability, cost effectiveness • To design a detail project that includes various infrastructural elements complying codes of practices and guidelines set by authorities			
COURSE CONTENT			
Capstone I: This course is the first part to an Integrated Design Project. The course aims to synergies all the basic engineering knowledge gained previously to solve real civil engineering problems in an integrated and comprehensive manner. Students will be first exposed to the importance of good design concepts that considers important characteristics including public health and safety, society and culture, environment and sustainability, authorities' requirements, as well as project cost effectiveness. Students will work in groups to observe existing project to evaluate the pros and cons of project characteristics. Each group will propose design concepts for earthworks, retaining structures, drainage, roads, water supply and sewerage systems etc. whatever required. Preparation and presentation of report will be done at the end of the course by the students. Capstone II: This course is a continuation of the Integrated Design Project I. It is referred to as a capstone project that integrates the various knowledge and skills in the various fields and core disciplines within Civil Engineering. Students are tasked to work in groups to develop the design of integrated infrastructural and structural elements for a development project from inception of the concepts until the production of detailed design and drawings. Aspects of environment and sustainability, public health and safety, culture and society, and cost effectiveness are to be considered in the process. The project includes various infrastructural elements such as platforms (earthworks), erosion control plan, slope stability/retaining, roads, drainage, detention pond, water supply, sewerage systems, and structural and foundation systems, including any other required elements. The design must comply with criteria set by the relevant Codes of Practice, and guidelines and conditions set by authorities, technical departments and professional bodies, as well as other			

requirements related to the public and society. Students are required to produce group design report and perform presentation. The successful implementation of the design project requires close cooperation between all team members. Hence, it is important for students to assume full responsibility in executing individual assignments and at the same time possess good team spirit to ensure the success of the project.

COURSE OUTCOMESAND SKILL MAPPING

No.	COURSE OUTCOMES (COs)	PROGRAMME OUTCOMES (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Able to **develop** preliminary design concepts of integrated Civil Engineering project that makes appropriate consideration of project management, cost effectiveness, and authorities' requirements.			√									
2	Able to **describe** project's authorities' conditions and other relevant needs related to "Engineers and Society".						√						
3	Able to **produce** report and **present** preliminary design concept of the integrated project.										√		
4	Able to critically **assess** and **evaluate** the project site with respect to gained knowledge and field data analysis		√										
5	Able to **develop** integrated project design solutions that considers environment and sustainability, public health and safety, culture and society, and cost effectiveness, etc. by applying relevant codes of practice and guidelines			√									
6	Able to **run** computer softwares in the design process, preparation of drawings, reports and presentations (Excel,					√							

	AutoCAD and other design softwares)												
7	Able to **produce** presentable capstone project report containing executive summary, introduction, tasks distribution, concepts, design calculations, drawings, conclusions, etc and **present verbally** in presentation session or interview										√		
8	Able to **perform** tasks individually and be an effective group member									√			
9	Able to **apply** strategies to achieve cost effectiveness, and estimating cost of selected components											√	
10	Able to **produce** infrastructural and structural elements design that considers the effect on environment and demonstrate knowledge and sensitivity towards sustainable development							√					

<u>Program Outcomes (PO)</u>:
PO1: Engineering knowledge, **PO2**: Problem analysis, **PO3**: Design/development of solutions, **PO4**: Investigation, **PO5**: Modern tool usage, **PO6**: The engineer and society, **PO7**: Environment and sustainability, **PO8**: Ethics, **PO9**: Individual and teamwork, **PO10**: Communication, **PO11**: Project management and finance, **PO12**: Life-long learning

COURSE OUTCOMES AND GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	P	A	K	Assessment Methods
CO1	Able to **develop** preliminary design concepts of integrated Civil Engineering project that makes appropriate consideration of project management, cost	3	C6	1, 2	1	3, 4	Proposal

	effectiveness, and authorities' requirements.						
CO2	Able to **describe** project's authorities' conditions and other relevant needs related to "Engineers and Society".	6	C2	6	4	-	Proposal
CO3	Able to **produce** report and **present** preliminary design concept of the integrated project.	10	-	-	-	-	Proposal + Presentation
CO4	Able to critically **assess** and **evaluate** the project site with respect to gained knowledge and field data analysis	2	C5	1, 3	2	3	Report
CO5	Able to **develop** integrated project design solutions that considers environment and sustainability, public health and safety, culture and society, and cost effectiveness, etc. by applying relevant codes of practice and guidelines	3	C6	1, 5	1, 2	5, 6	Report
CO6	Able to **run** computer softwares in the design process, preparation of drawings, reports and presentations (Excel, AutoCAD and other design softwares)	5	-	1, 3	3	4, 5	Report + Presentation
CO7	Able to **produce** presentable capstone project report containing executive summary, introduction, tasks distribution, concepts, design calculations, drawings, conclusions, etc and **present verbally** in presentation session or interview	10	-	-	-	7	Presentation
CO8	Able to **perform** tasks individually and be an effective group member	9	-	-	-	-	Observation
CO9	Able to **apply** strategies to achieve cost effectiveness,	11	C3	1, 2	-	-	Report

	and estimating cost of selected components						
CO10	Able to **produce** infrastructural and structural elements design that considers the effect on environment and demonstrate knowledge and sensitivity towards sustainable development	7	C6	1, 6	3, 4	5	Report

Knowledge Profile (K):

K1: Natural sciences, **K2**: Mathematics, **K3**: Engineering fundamentals, **K4**: Specialist knowledge, **K5**: Engineering design, **K6**: Engineering practice, **K7**: Comprehension, **K8**: Research literature

Complex Engineering Problem (P):

P1: Depth of knowledge required, **P2**: Range of conflicting requirements, **P3**: Depth of analysis required, **P4**: Familiarity of issues, **P5**: Extent of applicable codes, **P6**: Extent of stakeholder involvement and conflicting requirements, **P7**: Interdependence

Complex Engineering Activities (A):

A1: Range of resources, **A2**: Level of interactions, **A3**: Innovation, **A4**: Consequences to society and the environment, **A5**: Familiarity

Bloom's Taxonomy Levels:

C1: Remember, **C2**: Understand, **C3**: Apply, **C4**: Analyze, **C5**: Evaluate, **C6**: Create

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face to Face Learning 2 hrs/week in 4/I and 6 hrs/week in 4/II	40
Guided Learning Data Collection/ Analysis/ Model Study	60
Independent Learning Individual learning Preparation for Viva and presentation	10 5
Assessment Proposal Report Presentation	1 3 1
Total	120

TEACHING METHODOLOGY
Analytical/ Experimental/ Modeling

TEACHING SCHEDULE			
Guided by a Group of Supervisors CO1 – CO3: in 4/I and CO4 – CO10: in 4/II			
ASSESSMENT STRATEGY			
Components	**Grading**	**CO**	**Blooms Taxonomy**
Proposal Writing with Presentation	20%	CO1, CO2, CO3	C2, C6
Report	50%	CO4, CO5, CO9, CO10	C3, C5, C6,
Presentation	30%	CO6, CO7, CO8	-
Total Marks	100%		

REFERENCE BOOKS

1. Gould F. E. and Joyce N. E. 2003. Construction Project Management. 2nd Ed. Prentice Hall.
2. Colin Harding, Chartered Institute of Building, 2015. Integrated Design and Construction. Wiley Blackwell
3. Brad Hardin & Dave McCool, 2014. BIM and Construction Management: Proven Tools, Methods, and Workflows, 2nd Edition.
4. Saleh A. Mubarak, 2015. Construction Project Scheduling and Control, 3rd Edition.
5. American Water Works Association / American Society of Civil Engineer, 2012. Water Treatment Plant Design. 5th Edition. McGraw Hill.
6. Shun Dar Lin, 2007. Water and Wastewater Calculations Manual. 2nd Edition. McGraw Hill.
7. Metcalf and Eddy, Wastewater Engineering 2016: Treatment Disposal and Reuse. 4th Edition. McGraw Hill.

Additional References:

Building Information Modelling (BIM) Aspects:

1. Karen, K. and Douglas, N., “Building Information Modelling: BIM in Current and Future Practice”, 1st edition, John Wiley & Sons, Inc., Hoboken, New Jersey, USA, 2014.
2. Robert, S.W., “BIM Content Development: Standards, Strategies, and Best Practices”, John Wiley & Sons, Inc., Hoboken, New Jersey, USA, 2011.
3. Darren, R., “Computer Modelling for Sustainable Urban Design”, Earthscan, Abingdon, Oxon, UK, 2011.
4. Nawari, O.N., “Building Information Modelling: Framework for Structural Design”, Apple Academic Press Inc., Waretown, New Jersey, USA, 2015.
5. Eddy, K. and James, V., “Mastering Autodesk Revit Architecture 2015: Autodesk Official Press”, John Wiley & Sons, Inc., Indianapolis, Indiana, USA, 2015.

Structural (RC and Steel Design) Aspects:

1. Design of Concrete Structures by – Nilson, David & Dolan (15th Edition)
2. Bhatt, P., MacGinley, T.J., and Choo, B.S., "Reinforced Concrete Design to Eurocodes: Design Theory and Examples", 4th edition, CRC, New York, USA, 2014.
3. Lam, D., Ang, T.C. and Chiew, S.P., “Structural Steelwork: Design to Limit State Theory”, 4th edition, CRC Press, Taylor & Francis Group, London, UK, 2014.
4. Gardner, L. and Nethercot, D.A., “Designers’ Guide to Eurocode 3: Design of Steel Structures – Designers’ Guide to EN 1993-1-1 Eurocode 3: Design of Steel Structures General Rules and Rules for Buildings”, Thomas Telford, London, UK, 2005.

5. Draycott, T. and Bullman, P., “Structural Elements Design Manual: Working with Eurocodes”, 2nd edition, Butterworth-Heinemann, Oxford, UK, 2009.

Construction Aspects:

1. Gould, F.E. “Managing the Construction Process”, Prentice Hall, 4th edition 2011.
2. Hinze, J.W. “Construction Planning and Scheduling”, Prentice Hall, 2011.
3. Callahan, M.T. “Construction Project Scheduling”, McGraw-Hill, 1992.
4. A Guide to the Project Management Body of Knowledge (Pmbok Guide) - 5th edition, Project Management Institute Inc., 2013.

Geotechnical Aspects:

1. Coduto, D.P., “Foundation Design – Principles and Practices”, 2nd edition, Prentice Hall, 2001.
2. Craig, R.F. and Knappett, J.A., “Craig’s Soil Mechanics”, 8th edition, Spon Press, 2012.
3. Das, B.M., “Principles of Foundation Engineering”, 8th edition, Cengage Learning, 2016.