CHAPTER 3

DEPARTMENT OF BIOMEDICAL ENGINEERING (BME)

3.1 Introduction to the Program

The Department of Biomedical Engineering, MIST, was founded in 2014 and started the academic program of the pioneer batch of Undergraduate Biomedical Engineers in the country. The B.Sc Program commenced on 1st February, 2015 with 41 students. The M.Sc Program commenced on 4th November 2015 with 5 students. Currently, there are a total of 161 students in the B.Sc Program and a total of 37 students in the M.Sc Program. Biomedical Engineering (BME) is an interdisciplinary field that combines the design and problem-solving skills of engineering with medical and biological sciences to advance healthcare treatment. Deeply interdisciplinary, biomedical engineering applies modern approaches from the experimental life sciences in conjunction with theoretical and computational methods from engineering, mathematics, and computer science to the solution of biomedical problems of fundamental importance, such as human health. This field seeks to close the gap between engineering and medicine, combining the design and problem-solving skills of engineering with medical and biological sciences to advance healthcare treatment, including diagnosis, monitoring, and therapy. The current focus of the BME Department includes the development of biocompatible implants and prostheses, various diagnostic and therapeutic medical devices ranging from clinical equipment, common biomedical imaging equipment, cell & tissue engineering, regenerative tissue growth, pharmaceutical drugs, and therapeutics.

3.2 Vision and Mission of the Program

Vision:

To become a locally reputed and globally recognized Biomedical Engineering Department through nurturing excellence in teaching, research, and industrial partnership towards advanced cutting-edge healthcare technologies.

Mission:

a. To provide quality education in the emerging and extremely interdisciplinary field of Biomedical Engineering, utilizing up-to-date teaching and learning facilities contributing to advanced healthcare technologies.

b. To formulate and implement a modern academic curriculum to develop professionally sound and ethically strong Biomedical Engineers to provide dedicated services in the healthcare sector of the nation.

c. To facilitate innovative and industry-linked research platforms to foster the development of cutting-edge technologies and their proficient applications.

d. To improve the quality of common peoples' life in Bangladesh using knowledge and skills of modern science and technology.

3.3 Program Educational Objective (PEOs)

No	PEO Statement
PEO-1	Provide graduates mathematical, scientific, and engineering fundamentals and advanced knowledge of understanding in the sector of Biomedical Engineering including analysis techniques, design, developments, and implementation methodologies
PEO-2	Integrate technical and communicative knowledge with professional and industry-based education to build up successful professional careers in industry, government, and academia
PEO-3	Expose graduate's problem-solving skills and research-based education for life-long learning to adapt the innovation and changes.
PEO-4	Make the graduates capable of working in the broader area of technology, having the capability and responsibility of leadership and teamwork.
PEO-5	Enable the graduates to establish and run sustainable business enterprises along diverse career paths by creating, selecting, applying appropriate and modern technologies and tools.
PEO-6	Contribute the educational, cultural, social, technological and economic development of society through the ethical application of their knowledge and skills.

3.4 Program Outcomes

Based on the suggestion of the Board of Accreditation for Engineering and Technical Education (BAETE), Bangladesh, the Bachelor in Biomedical Engineering (BME) program will have the following learning outcomes:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, research the literature and analyze complex engineering problems and reach substantiated conclusions using the first principles of mathematics, the natural sciences, and the engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal, and environmental concerns.

4. **Investigation:** Conduct investigations of complex problems, considering the design of experiments, analysis, and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to professional engineering practice.

7. **Environment and sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate sustainable development knowledge.

8. **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and the norms of the engineering practice.

9. **Individual work and teamwork:** Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.

10. **Communication:** Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work as a member or a leader of a team to manage projects in multi-disciplinary environments.

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

13. In addition to incorporating the above-listed POs, MIST also included the following Knowledge Profile (K1-K8) as an educational institution: may include additional outcomes in its learning programs. The ranges of Complex Problem Solving (P1 – P7) and Complex Engineering Activities (A1 – A5) that should be addressed in the program are given in Tables 3.2 and 3.3, respectively.

In addition to incorporating the above-listed POs, MIST also included the following Knowledge Profile (K1-K8) as an educational institution: may include additional outcomes in its learning programs. The ranges of Complex Problem Solving (P1 – P7) and Complex Engineering Activities (A1 – A5) that should be addressed in the program are given in Tables 3.2 and 3.3, respectively.

Table 3.1: Knowledge Profile (KP)

	Attribute
K1	A systematic, theory-based understanding of the natural sciences applicable to the discipline
K2	Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline
K3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
K4	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
K5	Knowledge that supports engineering design in a practice area
K6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
K7	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability
K8	Engagement with selected knowledge in the research literature of the discipline

Table 3.2: Range of Complex Engineering Problem Solving

Attribute	**Complex Engineering Problems** have characteristic P1 and some or all of P2 to P7:
Depth of knowledge required	P1: Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach
Range of conflicting requirements	P2: Involve wide-ranging or conflicting technical, engineering and other issues
Depth of analysis required	P3: Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models
Familiarity of issues	P4: Involve infrequently encountered issues
Extent of applicable codes	P5: Are outside problems encompassed by standards and codes of practice for professional engineering
Extent of stakeholder involvement and conflicting requirements	P6: Involve diverse groups of stakeholders with widely varying needs
Interdependence	P7: Are high level problems including many component parts or sub-problems

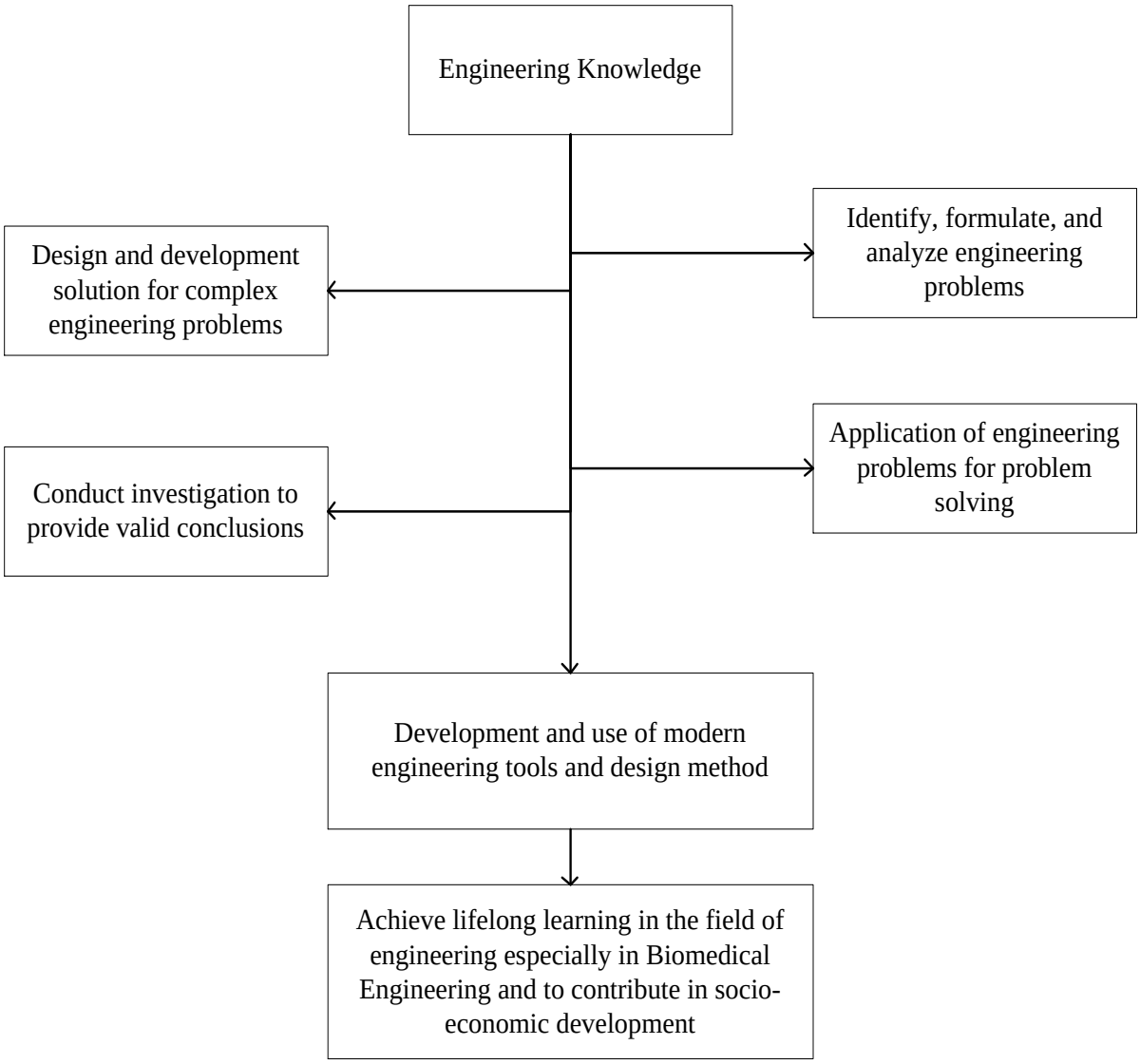
Table 3.3: Range of Complex Engineering Activities

Attribute	**Complex activities** means (engineering) activities or projects that have some or all of the following characteristics:
Range of resources	A1: Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies)
Level of interaction	A2: Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues
Innovation	A3: Involve creative use of engineering principles and research based knowledge in novel ways
Consequences for society and the environment	A4: Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation
Familiarity	A5: Can extend beyond previous experiences by applying principles-based approaches

3.5 Generic Skills

1. Apply the principles and theory of biomedical engineering knowledge to the requirements, design and development of different biomedical equipment and devices with appropriate understanding.
2. Define and use appropriate research methods and modern tools to conduct a specific project.
3. Learn independently, be self- aware, and self- manage their time and workload.
4. Apply critical thinking to solve complex engineering problems
5. Analyze real time problems and justify the appropriate use of technology
6. Work effectively with others and exhibit social responsibility

3.6 Curriculum/ Skill Mapping



CHAPTER 4

COURSE CURRICULUM FOR BACHELOR DEGREE IN BME

4.1 Course Schedule

Keeping the above mentioned program outcome, the course schedule for the undergraduate students of the Biomedical Engineering (BME) is given below:

Level/ Term	Basic Science		Math	General Education		Engineering Courses				Elective Course	Total
						Dept.		Non-Dept.			
	T	S	T	T	S	T	S	T	S	T	
L-1 T-I	6.00	3.00	3.00	-	-	2.00	-	3.00	1.50	-	18.50
L-1 T-II	6.00	-	3.00	4.00	1.50	3.00	1.50	-	-	-	19.00
L-2 T-I	-	-	3.00	2.00	1.50	3.00	-	6.00	3.00	-	18.50
L-2 T-II	-	-	3.00	-	-	9.00	4.50	3.00	1.50	-	21.00
L-3 T-I	-	-	-	2.00	-	12.00	3.00	3.00	1.50	-	21.50
L-3 T-II	-	-	-	-	-	12.00	7.50	-	-	-	19.50
L-4 T-I	-	-	-	2.00	-	9.00	4.50	-	-	6.00	21.50
L-4 T-II	-	-	-	4.00	-	6.00	4.50	-	-	6.00	20.50
% of Total Course	9.375		7.50	10.625		50.94		14.06		7.50	100.00
Total Credit Hr	15.00		12.00	17.00		81.50		22.50		12.00	160.00

T=Theory; S=Sessional

Table: Summary of Course Curriculum

4.2 Contact Hours and Credit Hours Distribution in Eight Terms

Level/Term	Theory Contact Hours	Sessional Contact Hours	Theory Credit Hours	Sessional Credit Hours	Total Contact Hours	Total Credit Hours
L-1 T-I	14.00	9.00	14.00	4.50	23.00	18.50
L-1 T-II	16.00	6.00	16.00	3.00	22.00	19.00
L-2 T-I	14.00	9.00	14.00	4.50	23.00	18.50
L-2 T-II	15.00	12.00	15.00	6.00	27.00	21.00
L-3 T-I	15.00	13.00	15.00	6.50	28.00	21.50
L-3 T-II	12.00	12.00+4 Weeks	12.00	7.50	24.00+4 Weeks	19.50
L-4 T-I	17.00	9.00	17.00	4.50	26.00	21.50
L-4 T-II	16.00	9.00	16.00	4.50	25.00	20.50
Total	119.00	79.00+4 Weeks	119.00	41.00	198.00+4 Weeks	160.00

4.3 Final Year

Final Year Design and Research Project

Final year design and research project will have to be undertaken by students under separate supervisors in partial fulfillment of the requirement of his/her degree. Credits allotted to the final year design and research project will be 6.00 corresponding to 12.00 contact hours. Topic and advisor selection of final year design and research project must be finalized within level-3, term-2.

4.4 BME Courses

The students have to complete all the core courses listed below:

4.4.1 List of Core Courses – BME

Ser	Course Code	Course Name	Credit Hour
1	BME 101	Introduction to Biomedical Engineering	2.0
2	BME 104	CAD in Biomedical Engineering Sessional	1.5
3	BME 105	Human Anatomy	3.0
4	BME 201	Human Physiology	3.0
5	BME 203	Biochemistry	3.0
6	BME 204	Biochemistry Sessional	1.5
7	BME 205	Biofluid Mechanics and Heat Transfer	3.0
8	BME 206	Biofluid Mechanics and Heat Transfer Sessional	1.5
9	BME 207	Biomedical Instrumentation and Measurements	3.0
10	BME 208	Biomedical Instrumentation and Measurements Sessional	1.5
11	BME 301	Statistics and Numerical Methods for Engineers	3.0
12	BME 303	Biomaterials	3.0
13	BME 304	Biomaterials Sessional	1.5
14	BME 305	Biomedical Signal Processing	3.0
15	BME 306	Biomedical Signal Processing Sessional	1.5
16	BME 307	Medical Imaging	3.0
17	BME 309	Diagnostic and Therapeutic Equipment-I	3.0
18	BME 311	Embedded Systems and Interfacing Sessional	1.5
19	BME 312	Embedded Systems and Interfacing	3.0
20	BME 313	Biomedical Image Processing	1.5
21	BME 314	Biomedical Image Processing Sessional	3.0
22	BME 315	Biomechanics	3.0

23	BME 316	Biomechanics Sessional	1.5
24	BME 318	Biomedical Engineering Design Sessional	1.5
25	BME 300	Industrial Training	1.5
26	BME 401	Diagnostic and Therapeutic Equipment-II	3.0
27	BME 403	Biomedical Transport Phenomenon	3.0
28	BME 405	Molecular Biology for Engineers	3.0
29	BME 406	Molecular Biology for Engineers Sessional	1.5
30	BME 407	Healthcare Technology Management	3.0
31	BME 409	Rehabilitation Engineering	3.0
32	BME 410	Rehabilitation Engineering Sessional	1.5
33	BME 400	Final Year Design and Research Project	6.0
Total			**81.5**

4.4.2 List of Courses – Basic Science and Mathematics

Ser	Course Code	Course Name	Credit Hour
1	PHY 101	Waves and Oscillations, Optics and Modern physics	3.0
2	PHY 102	Physics Sessional	1.5
3	PHY 109	Structure of matter, Electricity, Magnetism, and Mechanics	3.0
4	CHEM 101	Fundamentals of Chemistry	3.0
5	CHEM 102	Chemistry Sessional	1.5
6	CHEM 125	Physical and Bio-organic Chemistry	3.0
7	MATH 101	Differential and Integral Calculus	3.0
8	MATH 105	Vector Analysis, Matrix and Coordinate Geometry	3.0
9	MATH 205	Differential Equation, Laplace transform and Fourier Transform	3.0
10	MATH 231	Complex Variables and Linear Algebra	3.0
Total			**27.0**

4.4.3 List of Courses – General Education or Non-Skill and Language/ Communicative Language

Ser	Course Code	Course Name	Credit Hour
1	LANG 102	Communicative English I	1.5
2	GES 101	Fundamentals of Sociology	2.0
3	GEBS 101	Bangladesh Studies	2.0
4	GELM 271	Leadership and Management	2.0
5	LANG 202	Communicative English II	1.5
6	GERM 352	Fundamentals of Research Methodology (Sessional)	2.0
7	GEPM 481	Project Management and Finance	2.0
8	GESL 421	Environment, Sustainability and Law	2.0
9	GEEM 451	Engineering Ethics and Moral Philosophy	2.0
Total			**17.0**

4.4.4 List of Core Courses – Interdisciplinary

Ser	Course Code	Course Name	Credit Hour
1	EECE 191	Principles of Electrical Engineering	3.0
2	EECE 192	Principles of Electrical Engineering Sessional	1.5
3	EECE 291	Electronic Circuits and Devices	3.0
4	EECE 292	Electronic Circuits and Devices Sessional	1.5
5	EECE 391	Digital Electronics	3.0
6	EECE 392	Digital Electronics Sessional	1.5
7	ME 291	Principles of Mechanical Engineering	3.0
8	ME 292	Mechanical Engineering Lab	1.5
9	CSE 291	Computer Programming	3.0
10	CSE 292	Computer Programming Sessional	1.5
Total			**22.5**

4.4.5 BME Elective Courses

At least TWO elective courses must be taken from each group.

4.4.5.1 Group-I (Instrumentation)

Ser.	Course Code	Course Name	Credit Hour
1.	BME 411	Physiological Control System	3.0
2.	BME 413	Virtual Bioinstrumentation	3.0
3.	BME 415	Biophotonics	3.0
4.	BME 417	Equipment in Radiology and Radiotherapy	3.0

4.4.5.2 Group-II (Regenerative Medicine)

Ser.	Course Code	Course Name	Credit Hour
1.	BME 419	Tissue Engineering	3.0
2.	BME 421	Drug Development and Delivery System	3.0
3.	BME 423	Nanotechnology in Biomedicine	3.0
4.	BME 425	Artificial Organ Development	3.0

4.4.5.3 Group-III (Imaging)

Ser.	Course Code	Course Name	Credit Hour
1.	BME 427	Advanced Biomedical Signal Processing	3.0
2.	BME 429	Nuclear Medicine	3.0
3.	BME 431	Bioinformatics	3.0
4.	BME 433	Biomedical Data Science	3.0

4.4.5.4 Group-IV (Biomechanics and Rehabilitation Engineering)

Ser.	Course Code	Course Name	Credit Hour
1.	BME 435	Advanced Biofluid Mechanics	3.0
2.	BME 437	Biomedical Implants and Braces	3.0
3.	BME 439	Neuroscience and Neural Engineering	3.0
4.	BME 441	Biofabrication	3.0

4.5 Term-wise Distribution of Courses

4.5.1 LEVEL 1, TERM-I

Ser	Course Code	Course Name	Contact Hour	Credit Hour
1.	BME 101	Introduction to Biomedical Engineering	2.0	2.0
2.	PHY 101	Waves and Oscillations, Optics and Modern physics	3.0	3.0
3.	PHY 102	Physics Sessional	3.0	1.5
4.	CHEM 101	Fundamentals of Chemistry	3.0	3.0
5.	CHEM 102	Chemistry Sessional	3.0	1.5
6.	MATH 101	Differential and Integral Calculus	3.0	3.0
7.	EECE 191	Principles of Electrical Engineering	3.0	3.0
8.	EECE 192	Principles of Electrical Engineering Sessional	3.0	1.5
Total			**23.0**	**18.5**

4.5.2 LEVEL 1, TERM-II

Ser	Course Code	Course Name	Contact Hour	Credit Hour
1.	BME 104	CAD in Biomedical Engineering Sessional	3.0	1.5
2.	BME 105	Human Anatomy	3.0	3.0
3.	PHY 109	Structure of matter, Electricity and Magnetism, and Mechanics	3.0	3.0
4.	CHEM 125	Physical and Bio-organic Chemistry	3.0	3.0
5.	MATH 105	Vector Analysis, Matrix and Coordinate Geometry	3.0	3.0
6.	GES 101	Fundamentals of Sociology	2.0	2.0
7.	GEBS 101	Bangladesh Studies	2.0	2.0
8.	LANG 102	Communicative English I	3.0	1.5
Total			**22.0**	**19.0**

4.5.3 LEVEL 2, TERM-I

Ser	Course Code	Course Name	Contact Hour	Credit Hour
1.	BME 201	Human Physiology	3.0	3.0
2.	MATH 205	Differential Equation, Laplace transform and Fourier Transform	3.0	3.0
3.	EECE 291	Electronic Circuits and Devices	3.0	3.0
4.	EECE 292	Electronic Circuits and Devices Sessional	3.0	1.5
5.	CSE 291	Computer Programming	3.0	3.0
6.	CSE 292	Computer Programming Sessional	3.0	1.5
7.	GELM 271	Leadership and Management	2.0	2.0
8.	LANG 202	Communicative English II	3.0	1.5
Total			**23.0**	**18.5**

4.5.4 LEVEL 2, TERM-II

Ser	Course Code	Course Name	Contact Hour	Credit Hour
1.	BME 203	Biochemistry	3.0	3.0
2.	BME 204	Biochemistry Sessional	3.0	1.5
3.	BME 205	Biofluid Mechanics and Heat Transfer	3.0	3.0
4.	BME 206	Biofluid Mechanics and Heat Transfer Sessional	3.0	1.5
5.	BME 207	Biomedical Instrumentation and Measurements	3.0	3.0
6.	BME 208	Biomedical Instrumentation and Measurements Sessional	3.0	1.5
7.	ME 291	Principles of Mechanical Engineering	3.0	3.0
8.	ME 292	Mechanical Engineering Lab	3.0	1.5
9.	MATH 231	Complex Variables and Linear Algebra	3.0	3.0
Total			**27.0**	**21.0**

4.5.5 LEVEL 3, TERM-I

Ser	Course Code	Course Name	Contact Hour	Credit Hour
1.	BME 301	Statistics and Numerical Methods for Engineers	3.0	3.0
2.	BME 303	Biomaterials	3.0	3.0
3.	BME 304	Biomaterials Sessional	3.0	1.5
4.	BME 305	Biomedical Signal Processing	3.0	3.0
5.	BME 306	Biomedical Signal Processing Sessional	3.0	1.5
6.	BME 307	Medical Imaging	3.0	3.0
7.	EECE 391	Digital Electronics	3.0	3.0
8.	EECE 392	Digital Electronics Sessional	3.0	1.5
9.	GERM 352	Fundamentals of Research Methodology (Sessional)	4.0	2.0
Total			**28.0**	**21.5**

4.5.6 LEVEL 3, TERM-II

Ser	Course Code	Course Name	Contact Hour	Credit Hour
1.	BME 309	Diagnostic and Therapeutic Equipment-I	3.0	3.0
2.	BME 311	Embedded Systems and Interfacing	3.0	3.0
3.	BME 312	Embedded Systems and Interfacing Sessional	3.0	1.5
4.	BME 313	Biomedical Image Processing	3.0	3.0
5.	BME 314	Biomedical Image Processing Sessional	3.0	1.5
6.	BME 315	Biomechanics	3.0	3.0
7.	BME 316	Biomechanics Sessional	3.0	1.5
8.	BME 318	Biomedical Engineering Design Sessional	3.0	1.5
9.	BME 300	Industrial Training	4 weeks	1.5
Total			**24.0**	**19.5**

4.5.7 LEVEL 4, TERM-I

Ser	Course Code	Course Name	Contact Hour	Credit Hour
1.	BME 401	Diagnostic and Therapeutic Equipment-II	3.0	3.0
2.	BME 403	Biomedical Transport Phenomenon	3.0	3.0
3.	BME 405	Molecular Biology for Engineers	3.0	3.0
4.	BME 406	Molecular Biology for Engineers Sessional	3.0	1.5
5.	BME 4**	Elective 1	3.0	3.0
6.	BME 4**	Elective 2	3.0	3.0
7.	GEPM 481	Project Management and Finance	2.0	2.0
8.	BME 400	Final Year Design and Research Project	6.0	3.0
Total			**26.0**	**21.5**

4.5.8 LEVEL 4, TERM-II

Ser	Course Code	Course Name	Contact Hour	Credit Hour
1.	BME 407	Healthcare Technology Management	3.0	3.0
2.	BME 409	Rehabilitation Engineering	3.0	3.0
3.	BME 410	Rehabilitation Engineering Sessional	3.0	1.5
4.	BME 4**	Elective 3	3.0	3.0
5.	BME 4**	Elective 4	3.0	3.0
6.	GESL 421	Environment, Sustainability and Law	2.0	2.0
7.	GEEM 451	Engineering Ethics and Moral Philosophy	2.0	2.0
8.	BME 400	Final Year Design and Research Project	6.0	3.0
Total			**25.0**	**20.5**

4.5.9 List of Elective Courses

At least TWO elective courses must be taken from each group.

Group-I (Instrumentation)

Ser.	Course Code	Course Name	Credit Hour
1.	BME 411	Physiological Control System	3.0
2.	BME 413	Virtual Bioinstrumentation	3.0
3.	BME 415	Biophotonics	3.0
4.	BME 417	Equipment in Radiology and Radiotherapy	3.0

Group-II (Regenerative Medicine)

Ser.	Course Code	Course Name	Credit Hour
1.	BME 419	Tissue Engineering	3.0
2.	BME 421	Drug Development and Delivery System	3.0
3.	BME 423	Nanotechnology in Biomedicine	3.0
4.	BME 425	Artificial Organ Development	3.0

Group-III (Imaging)

Ser.	Course Code	Course Name	Credit Hour
1.	BME 427	Advanced Biomedical Signal Processing	3.0
2.	BME 429	Nuclear Medicine	3.0
3.	BME 431	Biomedical Data Science	3.0
4.	BME 433	Bioinformatics	3.0

Group-IV (Biomechanics and Rehabilitation Engineering)

Ser.	Course Code	Course Name	Credit Hour
1.	BME 435	Advanced Biofluid Mechanics	3.0
2.	BME 437	Biomedical Implants and Braces	3.0
3.	BME 439	Neuroscience and Neural Engineering	3.0
4.	BME 441	Biofabrication	3.0