

**CHAPTER - 2****THE DEPARTMENT OF BIOMEDICAL ENGINEERING (BME)**

2.1 **Introduction.** Biomedical Engineering (BME) is the application of engineering principles and design concepts to medicine and biology for healthcare purposes e.g. diagnostic or therapeutic. This field seeks to close the gap between engineering and medicine. It combines the design and problem solving skills of engineering with medical and biological sciences to advance healthcare treatment, including diagnosis, monitoring, and therapy. The new generation of biomedical engineers is encouraged to undertake research and development activities in the above areas and this department is committed to the study and analysis of fundamental as well as applied problems. Problems of military and national importance have consequently received great emphasis in the activities of this department. In addition to the above in future there will be opportunity for postgraduate studies and research leading to a higher degrees i.e. M. Sc. (Engg), M. Engg, and Ph.D in the related fields.

2.2 **Laboratory Facilities of the Department.** The department endeavors to provide its faculty members and students adequate laboratory, library and other facilities. Departmental undergraduate courses are laboratory intensive and these requirements catered by following laboratories:

- a. Electrical Circuit Laboratory
- b. Electrical Circuit Simulation Laboratory
- c. Computer Programming Laboratory
- d. Electrical Machine Laboratory
- e. Biomedical Engineering Design Laboratory
- f. Biomedical Engineering Teaching Laboratory
- g. Biomedical Instrumentation and Measurement Laboratory
- h. Digital Signal Processing Laboratory
- j. Biomaterials Laboratory
- k. Microprocessor and Interfacing Laboratory
- l. Biomedical Control System Laboratory
- m. Biomechanics Laboratory
- n. Electro-medical Equipment Laboratory
- p. Biomedical Image Processing Laboratory
- q. Molecular Modeling Laboratory
- r. Artificial Brace and Limb Development Laboratory
- s. Drug Development and Biomedicine Laboratory
- t. Cell and Tissue Engineering Laboratory
- u. Molecular Biology Laboratory
- v. Medical Implants Laboratory

Students in Level 1 (freshman) and Level 2 (sophomore) have to undertake laboratory classes in Physics, Chemistry, English, Computer Science, Mechanical and Civil Engineering too. If necessary undergraduate students can access the facilities of other departments and centers during project, thesis and research works.

**CHAPTER - 3**

**RULES AND REGULATIONS FOR UNDERGRADUATE PROGRAMME**

3.1 **Number of Terms in a Year (Level).** There will be two regular terms (Term I and Term II) in an academic year. Those who will not be able to clear all the subjects will require appearing in the re-examination after a short term of about 6 weeks and fulfilling the other conditions as per policy.

3.2 **Duration of Terms.**The duration of each of term will be as follows:

Events	Durations			Remarks
	Academic	Others	Total	
Classes	7 weeks			
Mid Term Vacation		1 week		
Classes (7 weeks minimum),	7 Weeks			
Makeup and Preparatory Leave		2 weeks		
Term Final Examination	2 weeks			
Term End Vacation		2 weeks		May Change
<b>Total</b>	16 weeks	5 weeks	<b>21 weeks</b>	

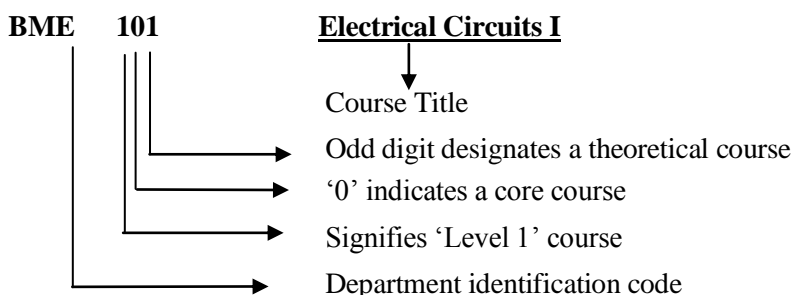
The duration for referred examination will be as follows:

Short term/ Preparatory Leave	* 6 weeks	* Duration may vary depending on the situation.
Examination	1 weeks	
<b>Total</b>	<b>7 Weeks</b>	

3.3 **Course Pattern and Credit Structure.** The undergraduate program is covered by a set of theoretical courses along with a set of laboratory courses to support them.

3.3.1 **Course Designation System.** Each course is designated by a two to four letter code identifying the department offering the course followed by a three-digit number having the following interpretation:

- a. The first digit corresponds to the year/level in which the students normally take the course.
- b. The second digit is reserved for departmental use. It usually identifies a specific area/group of study within the department having following interpretation:
  - 0 or 1 - Core courses
  - 2 or 9 - Interdisciplinary
  - 3 or 4 - Communication Group
  - 5 or 6 - Electronics Group
  - 7 or 8 - Power Group
- c. The last digit is an odd number for theoretical courses and an even number for laboratory courses.
- d. The course designation system is illustrated as follows:



3.3.2 **Assignment of Credits .** The assignment of credits to theoretical course is different from that of laboratory course, which is stated as follows:

- a. For theoretical courses one lecture per week per term is equivalent to one credit.
- b. For laboratory courses two class hours per week per term is equivalent to one credit.
- c. Credits are also assigned to project work taken by the students. The amount of credits assigned to such work may vary from one discipline to another.

3.3.3 **Types of Courses** . The 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. **Elective Courses.** Apart from the core courses, the students can choose from a set of elective courses. There are total eight elective courses as mentioned in Para 6.2 Choice of elective courses are as following:
  - (1) Three from individual group
  - (2) The rest two from individual group or other groups or interdisciplinary group or combination of these groups.

### 3.4 **The Grading System.**

3.4.1 **The Letter Grade.** 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 evaluation, class participation, homework, assignment and a term final examination. The assessment in laboratory courses is made by evaluating performance of the student at work during the class, viva-voce during laboratory hours and quizzes. Each course has a certain number of credits, which describes its corresponding weightages. A letter grade with a specified number of grade points is awarded in each course for which a student is registered. 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. 160.0 credits have to be acquired in order to qualify for the degree. Letter grades and corresponding grade points will be awarded in accordance to the provisions shown below:

Grade	Grade Points	Numerical Markings
A+	4.0	80% and above
A	3.75	75% to below 80%
A-	3.50	70% to below 75%
B+	3.25	65% to below 70%
B	3.00	60% to below 65%
B-	2.75	55% to below 60%
C+	2.50	50% to below 55%
C	2.25	45% to below 50%
D	2.00	40% to below 45%
F*	0.00	Below 40%
X	-	Continuation (For project/ thesis)

\* Subject in which the student gets 'F' grades will not be counted towards credit hours requirements and for the calculation of Grade Point Average (GPA)

3.4.2 **Distribution of Marks.** Thirty percent (30%) of marks of a theoretical course shall be allotted for continuous assessment, i.e. quizzes, home assignments, class evaluation and class participation. The rest of the marks will be allotted to the term final examination that is conducted centrally by the Dhaka University. There are internal and external examiners for each course in the term final examination of 3-hour duration. Distribution of marks for a given course is as follows:

Class Participation/Observation	10%
Class Attendance	10%
Homework assignment and quizzes	20%
Final Examination (3 hours)	60%
<b>Total</b>	<b>100%</b>

Basis for awarding marks for class participation and attendance will be as follows:

	Marks
90% and above	10
85% to less than 90%	9
80% to less than 85%	8
75% to less than 80%	7
70% to less than 75%	6
65% to less than 70%	5
60% to less than 65%	4
Below 60%	0

The number of quizzes of a course shall be  $n+1$ , where  $n$  is the number of credits of the course. Evaluation of performance in quizzes will be on the basis of the best  $n$  quizzes. The scheme of continuous assessment that a particular teacher wishes to follow for a course will be announced on the first day of classes.

3.4.3 **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

$$GPA = \frac{\sum_{i=1}^n C_i * G_i}{\sum_{i=1}^n C_i}$$

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  $GPA_1, GPA_2, \dots, GPA_n$  respectively then

$$CGPA = \frac{\sum_{i=1}^n TC_i * GPA_i}{\sum_{i=1}^n TC_i}$$

**A Numerical Example**

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

Course	Credits, $C_i$	Grade	Grade Points, $G_i$	$C_i * G_i$
EECE 101	3.00	A-	3.50	10.500
EECE 102	1.50	A+	4.00	6.000
EECE 103	3.00	A	3.75	11.250
EECE 104	1.50	B+	3.25	4.875
Phy 111	3.00	B-	2.75	8.250
Phy 112	1.50	C+	2.50	3.750
Chem 111	3.00	D	2.00	6.000
Chem 112	1.50	C	2.25	3.375
Math 111	3.00	B	3.00	9.000
<b>Total</b>	<b>21.00</b>			<b>63.000</b>

$$\text{GPA} = 63.000/21.00 = 3.00$$

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

Level	Term	Credit Hours Earned, $TC_i$	GPA Earned, $GPA_i$	$GPA_i * TC_i$
1	1	21.00	3.73	78.330
1	2	20.50	3.93	80.565
2	1	19.75	3.96	78.210
2	2	20.25	4.00	81.000
<b>Total</b>		<b>81.50</b>		<b>318.105</b>

$$\text{CGPA} = 318.105/81.50 = 3.90$$

3.4.4 **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 GPA requirement for obtaining a Bachelor's degree in engineering and other discipline is 2.20.

3.5 **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 for any reason 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).

**CHAPTER - 4****COURSE REQUIREMENT FOR THE UNDERGRADUATE STUDY OF  
BIOMEDICAL ENGINEERING**

4.1 **Introduction.** Biomedical Engineering (BME) is the application of engineering principles and design concepts to medicine and biology for healthcare purposes e.g. diagnostic or therapeutic. This field seeks to close the gap between engineering and medicine. It combines the design and problem solving skills of engineering with medical and biological sciences to advance healthcare treatment, including diagnosis, monitoring, and therapy. The list of courses offered to the undergraduate students of Biomedical Engineering (BME) is categorized into Core courses and Elective courses. Some of the core courses are offered by the Department of BME and some by other departments. 4 elective courses from the offered list have to be completed by the student in their 4<sup>th</sup> level. Each elective course will have 3.0 credit hour lecture.

4.2 **BME Courses.** The students have to complete all the core courses listed below:

4.2.1 **List of Core Courses – BME.**

Ser	Course Number	Course Name	Credit Hour
1.	BME 101	Introduction to Biomedical Engineering	3.0
2.	BME 103	Introduction to Living Cells and Human Anatomy	3.0
3.	BME 106	CAD in Biomedical Engineering Sessional	1.5
4.	BME 201	Bioelectricity	3.0
5.	BME 203	Biofluid Mechanics and Heat Transfer	3.0
6.	BME 204	Biofluid Mechanics and Heat Transfer Sessional	1.5
7.	BME 205	Human Physiology	3.0
8.	BME 206	Human Physiology 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	Principles of Diagnostic and Therapeutic Equipment	3.0
12.	BME 303	Biomaterials	3.0
13.	BME 305	Biomechanics	3.0
14.	BME 306	Biomaterials and Biomechanics Sessional	1.5
15.	BME 308	Biomedical Engineering Design-I Sessional	1.5
16.	BME 309	Embedded Systems and Interfacing	3.0
17.	BME 310	Embedded Systems and Interfacing Sessional	1.5
18.	BME 311	Medical Imaging	3.0
19.	BME 312	Medical Imaging Sessional	1.5
20.	BME 314	Industrial Training / Attachment	1.5
21.	BME 401	Physiological Control Systems	3.0
22.	BME 402	Physiological Control Systems Sessional	1.5

23.	BME 403	Molecular Biology for Engineers	3.0
24.	BME 405	Motion Analysis and Rehabilitation Engineering	3.0
25.	BME 406	Motion Analysis and Rehabilitation Engineering Sessional	1.5
26.	BME 407	Hospital Planning and Management	3.0
27.	BME 409	Professional Ethics	3.0
28.	BME 411	Biomedical Transport Fundamentals	3.0
29.	BME 412	Biomedical Engineering Design-II Sessional	1.5
33.	BME 400	Project/ Thesis	6.0
<b>Total</b>			<b>75.0</b>

#### 4.2.2 List of Courses –Science and Humanities.

Ser	Course Number	Course Name	Credit Hour
1.	PHY 191	Waves and Oscillations, Optics and Thermal Physics	3.0
2.	PHY 192	Physics Sessional	1.5
3.	MATH 191	Calculus	3.0
4.	CHEM 191	Organic & Inorganic Chemistry	3.0
5.	CHEM 192	Organic & Inorganic Chemistry Sessional	1.5
6.	HUM 191	English	3.0
7.	HUM 192	English Skills Sessional	1.5
8.	PHY 193	Structure of Matter, Modern Physics and Mechanics	3.0
9.	MATH 193	Complex Variables and Linear Algebra	3.0
10.	CHEM 193	Physical Chemistry	3.0
11.	CHEM 194	Physical Chemistry Sessional	1.5
12.	MATH 291	Differential Equations	3.0
13.	HUM 291	Economics	2.0
14.	CHEM 291	Biochemistry	3.0
15.	MATH 293	Probability & Statistics	3.0
16.	HUM 391	Sociology	2.0
<b>Total</b>			<b>40.0</b>

4.2.3 **List of Courses –EECE.**

Ser	Course Number	Course Name	Credit Hour
1.	EECE 191	Electrical Circuits	3.0
2.	EECE 192	Electrical Circuits Sessional	1.5
3.	EECE 291	Electronic Devices and Circuits	3.0
4.	EECE 292	Electronic Devices and Circuits Sessional	1.5
5.	EECE 293	Electrical Machines	3.0
6.	EECE 294	Electrical Machines Sessional	1.5
7.	EECE 391	Digital Electronics	3.0
8.	EECE 392	Digital Electronics Sessional	1.5
9.	EECE 393	Digital Signal Processing	3.0
10.	EECE 394	Digital Signal Processing Sessional	1.5
11.	EECE 395	Random Signals & Processes	3.0
12.	EECE 397	Solid State Devices	3.0
		<b>Total</b>	<b>28.5</b>

4.2.4 **List Core Courses – CSE.**

Ser	Course Number	Course Name	Credit Hour
1.	CSE 291	Computer Programming	3.0
2.	CSE 292	Computer Programming Sessional	1.5
		<b>Total</b>	<b>4.5</b>

4.2.5 **BME Elective Courses (at least TWO elective courses must be taken from each group).****Group-I (Biomechanics and Biomaterials)**

Ser	Course Number	Course Name	Credit Hour
1.	BME 413	Nanotechnology in Biomedicine	3.0
2.	BME 415	Artificial Organ Development	3.0
3.	BME 417	Drug Development and Delivery Systems	3.0
4.	BME 419	Tissue Engineering	3.0
5.	BME 421	Advanced Biofluid Mechanics	3.0

**Group-II (Biosystems, Imaging and Instrumentation)**

Ser	Course Number	Course Name	Credit Hour
1.	BME 423	Modeling of Physiological System	3.0
2.	BME 425	Biomedical Equipment & Device Development	3.0
3.	BME 427	Bioinformatics	3.0
4.	BME 429	Neuroscience and Neural Engineering	3.0
5.	BME 431	Medical Optics	3.0
6.	BME 433	Advanced Biomedical Signal Processing	3.0
7.	BME 435	Equipment in Radiology and Radiotherapy	3.0
8.	BME 437	Nuclear Medicine	3.0



4.2.6 **Summary of the Credit Hour Requirement.** To get B.Sc. Engineering degree in Biomedical Engineering (BME) following credits are to be earned:

Ser	Courses	Credit Hour
1.	BME Dept Core Courses	75.0
2.	BME Dept Elective Courses	12.0
3.	Courses to be offered by Sci & Hum Dept	40.0
4.	Courses to be offered by EECE Dept	28.5
5.	Courses to be offered by CSE Dept	4.5
<b>Total</b>		<b>160.0</b>

**SUMMARY OF COURSES**

Ser	Department	Total Credit Hour	Theory	Sessional
1.	BME (Core Courses)	75.0	57.0	18.0
2.	BME (Elective Courses)	12.0	12.0	–
3.	Sci & Hum	40.0	34.0	6.0
4.	EECE	28.5	21.0	7.5
5.	CSE	4.5	3.0	1.5
<b>Total</b>		<b>160.0</b>	<b>127.0</b>	<b>33.0</b>

**CHAPTER - 5****5.1 Term wise Distribution of Courses .****5.1.1 Level-1 Term-I.**

Ser	Course Number	Course Name	Contact Hour	Credit Hour
1.	BME 101	Introduction to Biomedical Engineering	3	3.0
2.	PHY 191	Waves and Oscillations, Optics and Thermal Physics	3	3.0
3.	PHY 192	Physics Sessional	3	1.5
4.	MATH 191	Calculus	3	3.0
5.	CHEM 191	Organic & Inorganic Chemistry	3	3.0
6.	CHEM 192	Organic & Inorganic Chemistry Sessional	3	1.5
7.	HUM 191	English	3	3.0
8.	HUM 192	English Skills Sessional	3	1.5
<b>Total</b>			<b>24</b>	<b>19.5</b>

**5.1.2 Level-1 Term-II.**

Ser	Course Number	Course Name	Contact Hour	Credit Hour
1.	BME-103	Introduction to Living Cells and Human Anatomy	3	3.0
2.	PHY 193	Structure of Matter, Modern Physics and Mechanics	3	3.0
3.	MATH 193	Complex Variables and Linear Algebra	3	3.0
4.	CHEM 193	Physical Chemistry	3	3.0
5.	CHEM 194	Physical Chemistry Sessional	3	1.5
6.	EECE 191	Electrical Circuits	3	3.0
7.	EECE 192	Electrical Circuits Sessional	3	1.5
8.	BME-106	CAD in Biomedical Engineering Sessional	3	1.5
<b>Total</b>			<b>24</b>	<b>19.5</b>

5.1.3 Level-2 Term-I.

Ser	Course Number	Course Name	Contact Hour	Credit Hour
1.	BME-201	Bioelectricity	3	3.0
2.	MATH 291	Differential Equations	3	3.0
3.	EECE 291	Electronic Devices and Circuits	3	3.0
4.	EECE 292	Electronic Devices and Circuits Sessional	3	1.5
5.	BME- 203	Biofluid Mechanics and Heat Transfer	3	3.0
6.	BME- 204	Biofluid Mechanics and Heat Transfer Sessional	3	1.5
7.	CSE 291	Computer Programming	3	3.0
8.	CSE 292	Computer Programming Sessional	3	1.5
9.	HUM 291	Economics	2	2.0
<b>Total</b>			<b>26</b>	<b>21.5</b>

5.1.4 Level-2 Term-II.

Ser	Course Number	Course Name	Contact Hour	Credit Hour
1.	BME- 205	Human Physiology	3	3.0
2.	BME- 206	Human Physiology Sessional	3	1.5
3.	CHEM 291	Biochemistry	3	3.0
4.	EECE 293	Electrical Machines	3	3.0
5.	EECE 294	Electrical Machines Sessional	3	1.5
6.	BME 207	Biomedical Instrumentation and Measurements	3	3.0
7.	BME 208	Biomedical Instrumentation and Measurements Sessional	3	1.5
8.	MATH 293	Probability & Statistics	3	3.0
<b>Total</b>			<b>24</b>	<b>19.5</b>

5.1.5 Level-3 Term-I.

Ser	Course Number	Course Name	Contact Hour	Credit Hour
1.	BME 301	Principles of Diagnostic and Therapeutic Equipment	3	3.0
2.	EECE 391	Digital Electronics	3	3.0
3.	EECE 392	Digital Electronics Sessional	3	1.5
4.	BME 303	Biomaterials	3	3.0
5.	BME 305	Biomechanics	3	3.0
6.	BME 306	Biomaterials and Biomechanics Sessional	3	1.5
7.	EECE 393	Digital Signal Processing	3	3.0
8.	EECE 394	Digital Signal Processing Sessional	3	1.5
9.	BME 308	Biomedical Engineering Design-I Sessional	3	1.5
<b>Total</b>			<b>27</b>	<b>21.0</b>

5.1.6 Level-3 Term-II.

Ser	Course Number	Course Name	Contact Hour	Credit Hour
1.	BME 309	Embedded Systems and Interfacing	3	3.0
2.	BME 310	Embedded Systems and Interfacing Sessional	3	1.5
3.	HUM 391	Sociology	2	2.0
4.	EECE 395	Random Signals & Processes	3	3.0
5.	EECE 397	Solid State Devices	3	3.0
6.	BME 311	Medical Imaging	3	3.0
7.	BME 312	Medical Imaging Sessional	3	1.5
8.	BME 314	Industrial Training / Attachment	¾ weeks	1.5
<b>Total</b>			<b>20</b>	<b>18.5</b>

# BME 314 (Industrial Training / Attachment) will be conducted at any convenient time after the term end exam of term-2 for a duration of ¾ weeks as applicable or decided by the department.

5.1.7 **Level-4 Term-I.**

Ser	Course Number	Course Name	Contact Hour	Credit Hour
1.	BME 401	Physiological Control Systems	3	3.0
2.	BME 402	Physiological Control Systems Sessional	3	1.5
3.	BME 403	Molecular Biology for Engineers	3	3.0
4.	BME 405	Motion Analysis and Rehabilitation Engineering	3	3.0
5.	BME 406	Motion Analysis and Rehabilitation Engineering Sessional	3	1.5
6.	BME 4**	Elective 1	3	3.0
7.	BME 4**	Elective 2	3	3.0
8.	BME 400	Project/ Thesis	6	3.0
<b>Total</b>			<b>27</b>	<b>21.0</b>

5.1.8 **Level-4 Term-II.**

Ser	Course Number	Course Name	Contact Hour	Credit hour
1.	BME 407	Hospital Planning and Management	3	3.0
2.	BME 409	Professional Ethics	3	3.0
3.	BME 411	Biomedical Transport Fundamentals	3	3.0
4.	BME 412	Biomedical Engineering Design-II Sessional	3	1.5
5.	BME 4**	Elective 3	3	3.0
6.	BME 4**	Elective 4	3	3.0
7.	BME 400	Project & Thesis	6	3.0
<b>Total</b>			<b>24</b>	<b>19.5</b>