HITEC UNIVERSITY

Taxila Cantt

SELF ASSESSMENT REPORT

BS Biomedical Engineering

Faculty of Engineering and Technology

HITEC UNIVERSITY

Heavy Industries Taxila Education City, Taxila Cantt-Pakistan

May 2023

Prepared by:	**Department of Biomedical Engineering**
Supervised by:	**Quality Enhancement Cell**
Reviewed by:	**QEC, Chairman, Dean, Vice-Chancellor**
Endorsed by:	**Chairman, Dean, Vice-Chancellor**

Table of Contents

List of Annexure

1.0 Executive Summary

This self-assessment report is being prepared for BS Biomedical Engineering from the Department of Biomedical Engineering as prescribed by Higher Education Commission. Quality Enhancement Cell was formed in HITEC University in 2011. Program Team and Assessment Team of Biomedical engineering department were formulated by University to collaborate with QEC to accomplish the following report in line with HEC guidelines with the support of Vice Chancellor and Department Heads.

This self-assessment report provides an analysis and evaluation of the academic standards followed and implemented by BS Biomedical Engineering Program. HEC prescribed Self-Assessment Manual is used as a reference and the program is being evaluated based on 8 criteria and 31 standards of quality improvement. First the Program teams of Biomedical Department made the report and then it was further assessed by the assessment team. The report finds the prospects of maintaining and continually enhancing academic standards and student's learning.

This report also investigates the strong and weak areas and other improvements needed by the department. A feedback is then provided in the form of corrective actions and implementation plan for quality assurance and improvement of academic programs in the future.

Objectives

a To initiate the quality improvement process through self-assessment as outlined by Higher Education Commission of Pakistan in order to improve the quality in higher education.

b To implement Self-Assessment Manual in BS Biomedical Engineering program with a view to improve program quality.

c To identify the areas requiring improvements and prepare the remedial actions in the form of an implementation plan.

Execution

The hierarchy of the execution tree was fundamental to the efficient working of all the stake-holders. Formulation of PT and AT was the very first step towards the goal.

The Self-Assessment Manual was distributed to all the faculty members for awareness and especially to the Program and Assessment Teams for SAR. Lectures and workshops were arranged for senior faculty members along with the Registrar, Treasurer, Controller of Examination, Deans and Vice-Chancellor, where qualified professionals of their respective fields taught the role of Quality and Accountability in education and especially in Higher Education.

The senior faculty members then became mentors for the junior faculty members and the knowledge of the subject spread to each and every faculty member along with supporting individuals/groups, until all were on the same page.

Following the lecturing and mentoring, a task distribution seminar was arranged by the chair of the Program Team. In this seminar, 8 criteria with 31 standards in total were distributed as tasks to various faculty members. An internal deadline of two months was given to all the task holders.

All task holders were instructed on the procedure of procurement of information for the completion of tasks. The information from various concerned departments of the university was to be obtained in written form along with initials of the information provider.

Once the criteria were ready, the task holder sent the soft copy for review and proof reading, to the chair of the Program Team. The chair reviewed and proof read in company with the Quality Representative of the respective Department. Once all the corrections and revisions were done in line with the Self-Assessment Manual, the task holders sent a signed hard copy and a soft copy to the chair of the Program Team who then incorporated the finished criteria into a single report and the report was given the shape of a draft.

This draft was then sent as a soft copy to the Quality Enhancement Cell, Chairman Biomedical Engineering Department, Dean and Vice-Chancellor who gave their valuable inputs.

The findings of the Assessment Team are given in the Annexure-J. It outlines the improvements required in the infrastructure, syllabi and training of the faculty and supporting staff. The implementation plan (Annexure-K) was prepared after discussion with all the stake-holders and it indicates the resources required to improve the quality.

Self-Assessment Report

2.0 Introduction

Heavy Industries Taxila Education City (HITEC) University is a private sector university. It was established in 2007 and chartered in 2009 by the Government of Punjab. The University is sponsored by Heavy Industries Taxila Education Welfare Trust (HITEWT). The university was established with a vision to produce skilled, moral, ethical and patriotic professionals who can serve the society and who will be the guardians of national, social and religious values.

University Mission Statement

HITEC University will be a center of excellence in teaching, learning and research. We shall instill and inspire intellectual curiosity, lifelong quest of knowledge and a keen urge for social and moral responsibility. The University will establish strong linkages with industry ensuring innovative research leading to economic prosperity of Pakistan.

Department of Biomedical Engineering

Department of Biomedical Engineering is currently running following intakes of the BS Biomedical Engineering Program.

a. BS Biomedical Engineering Session 2021

b. BS Biomedical Engineering Session 2022

Program Selected

HITEC University has selected the **BS Biomedical Engineering Program** as first model program for Self-Assessment Report (SAR) under the directives of Higher Education Commission (HEC). The selected program has been accredited by Pakistan Engineering Council (PEC).

Program Evaluation

The program is evaluated based on 8 criteria and 31 standards as given in the Self-Assessment Manual provided by HEC.

3.0 Criterion 1: Program Mission, Objectives and Outcomes

Standard 1-1

The program must have documented measurable objectives that support institution mission statements.

Program Mission Statement

To provide students with a strong foundation in engineering principles, as well as an understanding of the medical sciences. The department strives to impart appropriate engineering knowledge to students thereby enabling them to skillfully tackle any problem related to health care.

Program Objectives

The program is designed to achieve the following objectives:

1. To prepare the students to pursue career in relevant industry or pursue higher education in reputed universities.
2. To impart technical (designing, solution definition, implementation) and R&D skills in students.
3. To empower students to operate within the realm of ethical principles and contribute to the overall improvement of society.
4. To cultivate in students, the abilities of self-management, proficient presentation, and impactful communication.

Alignment of Program Objectives with Mission Statements

Program objectives intend to impart not only technical information to students but moral and ethical values as well. HITEC University provides a platform to students to acquire knowledge of pertinent fields and get hands on experience by extensive laboratory work

Main Elements of Strategic Plan

Curriculum Design

Curriculum of BS Biomedical Engineering comprises of 50 courses including core and electives. The curriculum is designed to build the basic concepts of the students. The goal is to help students in attaining deep insight of the relevant fields using different courses and practical work.

Core subjects include introduction to biomedical engineering, human anatomy, physiology, biomedical electronics, biomedical instrumentation, biomedical signal processing, Management and Entrepreneurship and communication skills to name a few. Elective courses can be selected from a wide range of available courses. See criterion 2, for detailed description of curriculum.

Practical Work

Students are required to go through extensive practical work in laboratories to implement the knowledge gained in theory class. Use of state of the art equipment helps students in grasping the concepts and observes the outcome of their experiments. The practical work in laboratories is segmented as follows:

a. Electronics and Instrumentation Laboratory Work
b. Biomechanics and Biomaterials Laboratory Work
c. Medical Sciences Laboratory Work
d. Computer Laboratory Work

Projects

During the program execution, every student is required to participate in multiple subject related projects during each semester. Every graduating student has to present final year project before evaluation committee. That is student's last year's work, based on design, analysis and implementation of a solution pertaining to engineering problems.

Internships/Industrial Experience

University arranges the internships for students at different stages during the execution of the program. The university keeps in touch with the potential industrial units/Hospitals for student's internship possibilities through a very well defined system. Office of Director Student Affairs approaches industries of repute every year and requests them to create internships vacancies for students of HITEC University. Students are informed to choose internships according to their major and location of the industry. Heavy Industries Taxila (HIT) gave approval for internships for up to 120 students of HITEC University.

Program Objectives Assessment

Program objectives are assessed once a batch passes out. As the first batch is yet to pass out, therefore the assessment is not carried out thus far.

Standard 1-2

The program must have documented outcomes for graduating students. It must be demonstrated that the outcomes support the program objectives and that graduating students are capable of performing these outcomes.

3.2.1 Program Outcomes

1. Students shall be well prepared for careers in variety of settings, including higher education, R&D, hospitals and industry.
2. Students shall be able to use various software and hardware tools related to Biomedical Engineering.
3. Students shall have effective communication skills.
4. Students shall be able to analyze, design, develop and implement solutions for various systems.
5. Students shall be able to perform cutting-edge research in relevant fields.
6. Students shall be able to execute tasks with a sense of social responsibility, ensuring a positive and constructive approach.

Program Objectives	Program Outcomes					
	1	2	3	4	5	6
1	x				x	
2		x		x		
3						x
4			X			

Table: Outcomes versus Objectives

3.2.2 Standard 1-3

The results of Program assessment and the extent to which they are used to improve the program must be documented.

The program assessment has been done by launching HEC Performa number 1 and 10. The students of the program evaluated the courses and teachers in the program.

Course Evaluation

Courses evaluation is shown in the following graphical chart:

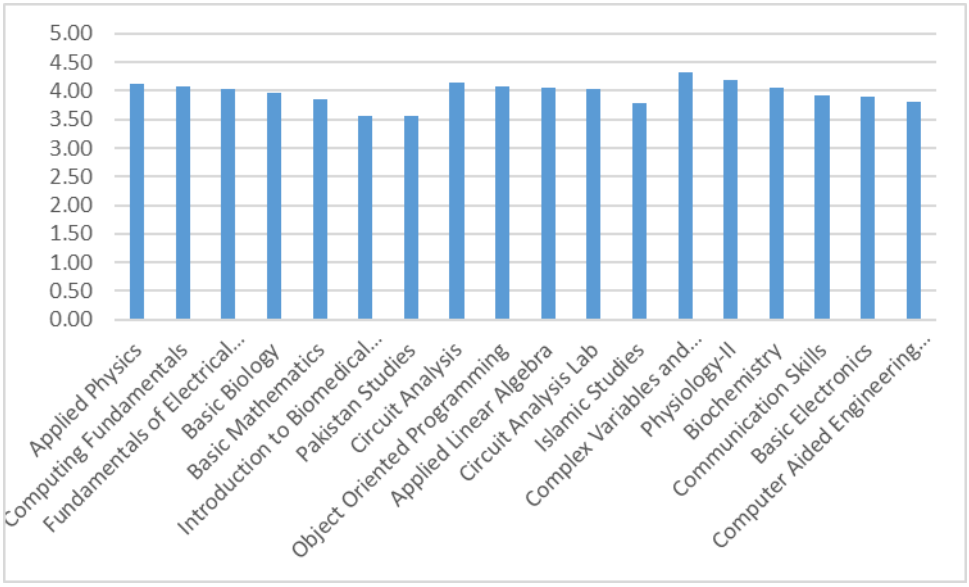

Figure 1: Course Evaluation Bar Chart

Through this evaluation, students have graded the courses against the structure, method of teaching, learning outcomes, objectives and practical implementation of theory. The total graded marks are 5.

See Annexure C (Course Evaluation Survey) for sample course evaluation results. The sample shows the results for one course only while the same has been done for all courses listed below. The results of all other courses have been kept in a separate file for record purposes. Following is the list of courses that are being evaluated by the students along with their course code and graded scores.

Sr. #	Course Name	Evaluation
01	Applied Physics	4.13

02	Computing Fundamentals	4.07
03	Fundamentals of Electrical Engineering	4.03
04	Basic Biology	3.97
05	Basic Mathematics	3.85
06	Introduction to Biomedical Engineering	3.57
07	Pakistan Studies	3.56
08	Circuit Analysis	4.15
09	Object Oriented Programming	4.08
10	Applied Linear Algebra	4.05
11	Circuit Analysis Lab	4.04
12	Islamic Studies	3.79
13	Complex Variables and Transforms	4.32
14	Physiology-II	4.19
15	Biochemistry	4.05
16	Communication Skills	3.91
17	Basic Electronics	3.89
18	Computer Aided Engineering Drawing	3.80

Teachers Evaluation

Teacher's evaluation for semester fall 2022 is shown in the following graphical charts:

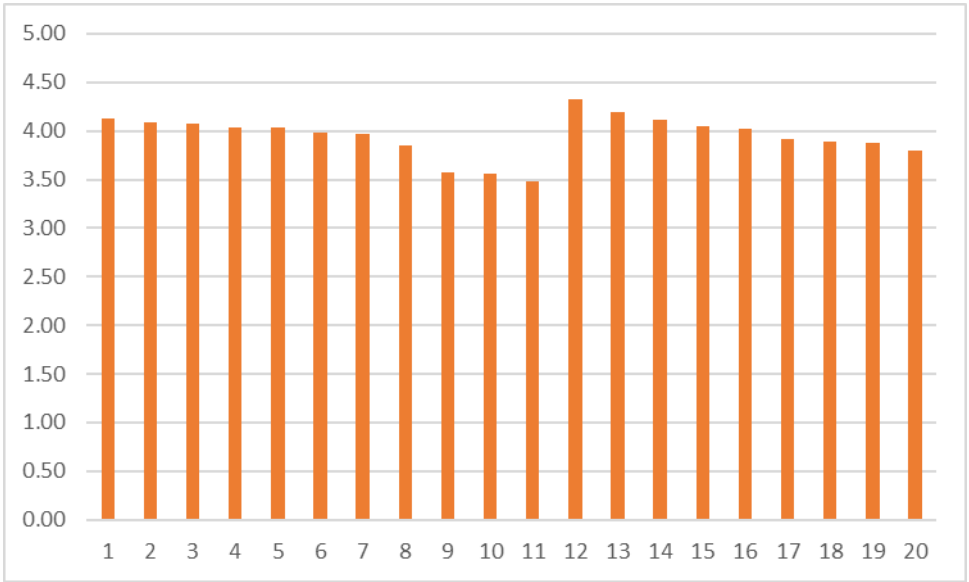

Figure 2: Teachers Evaluation Graph

Through this evaluation, students have graded the teachers against lecture preparation, punctuality, general behavior, subject knowledge and teaching method. The total graded marks are 5. See Annexure D (Teachers Evaluation Survey) for sample teacher evaluation results. The sample shows the results for one teacher only while same has been done for all teachers listed below. The results of all other teachers have been kept in a separate file for record purposes.

Following is the list of teachers that are being evaluated by the students along with the serial number and graded scores.

S. No.	Name	Subject	Evaluation
1	Teacher 1	Applied Physics	4.13
2	Teacher 2	Applied Physics Lab	4.09
3	Teacher 3	Computing Fundamentals	4.07
4	Teacher 4	Computing Fundamentals Lab	4.04
5	Teacher 5	Fundamentals of Electrical Engineering	4.03
6	Teacher 6	Fundamentals of Electrical Engineering Lab	3.98
7	Teacher 7	Basic Biology	3.97
8	Teacher 8	Basic Mathematics	3.85
9	Teacher 9	Introduction to Biomedical Engineering	3.57
10	Teacher 10	Pakistan Studies	3.56
11	Teacher 11	Quran Teachings: Beliefs	3.48
12	Teacher 12	Complex Variables and Transforms	4.32
13	Teacher 13	Physiology-II	4.19
14	Teacher 14	Physiology-II Lab	4.11
15	Teacher 15	Biochemistry	4.05
16	Teacher 16	Biochemistry Lab	4.02
17	Teacher 17	Communication Skills	3.91
18	Teacher 18	Basic Electronics	3.89
19	Teacher 19	Basic Electronics Lab	3.88
20	Teacher 20	Computer Aided Engineering Drawing	3.80

Note: The detailed list of evaluation is with Quality Enhancement Cell and can be provided on request.

The Dean and the Chairman of Program discussed the teacher evaluation results and decided to carry out counseling of teachers who are below par. It was also decided to conduct training sessions for teachers who are not performing at expected level.

The strengths and weaknesses of the program are:

Strengths

a. Coherent, monitored and uninterrupted semester system
b. Experienced faculty with strong track record of research and teaching.
c. Modern day application oriented course contents

Weaknesses

a. Low percentage of design contents in syllabi
b. Low number of case studies
c. Training of junior faculty members

Significant future development plans for the program include improvement in sound systems and up gradation of lab equipment. On the academic side, the future development plans for the programs include training programs for junior faculty members to enhance their teaching capabilities and revision of course syllabi. In addition to this, overall enhancement of knowledge and skills of all faculty members in relation to the latest global advancements in biomedical engineering through short trainings and collaborative research projects within and outside Pakistan are also under consideration.

Standard 1-4

The department must assess its overall performance periodically using quantifiable measures.

3.1.1 Graduates/Undergraduates enrolled in last three years

A total of 59 students enrolled during the last two years. The yearly breakdown is as follows:

- Year 2021 26
- Year 2022 33

Students, who enrolled during the last two years, have not yet graduated.

3.1.2 Student Faculty Ratio:

8-1

3.1.3 Average GPA per semester:

Average GPA per semester for the batch enrolled in year 2021 is as under:

Semester 1	2.78
Semester 2	3.00
Semester 3	2.97

Currently session 2021 is in semester 4.

3.1.4 Average Completion time

Average Completion time for undergraduate program is 4 years.

3.1.5 Employer Satisfaction

Employer satisfaction survey is under process, annexure B.

3.1.6 Students Course Evaluation Rate

Average student evaluation for all courses is 3.97 out of 5.

3.1.7 Students Faculty Evaluation

Students were asked to evaluate their faculty. The feedback was taken by QEC staff in the absence of faculty members. 63% teachers (15 out of 28) were awarded more than 80% evaluation grade by students. Whereas 43% teachers (12 out of 28) were awarded from 70% to 80%.

3.1.8 Research

The program faculty published 19 research papers in different impact factor journals from 2015 to 2023. List attached in Annexure E.

3.1.9 Community Service

HITEC University provides financial assistance for deserving students. It also takes part in disaster relief programs to help victims of flood, earthquake etc. University has its association with different blood donor clubs and it arranges blood camps on regular periods. University also actively takes part in environmental awareness activities and celebrates events like green day etc.

3.1.10 Students/Teachers Satisfaction

The department maintains a ratio of 6:1 for the academic (technical) and administrative non-technical staff which fulfills the standard set by the HEC.

Students indicated mix reactions to QEC staff while taking feedback. A reasonably good percentage was happy with university environment and administrative support services of the department. While, a few gave suggestion for improvements in administrative facilities like canteen and games.

The feedback from faculty also showed mix reactions regarding prevailing environment.

4.0 Criterion 2: Curriculum Design and Organization

Title of Degree Program
BS Biomedical Engineering
Definition of credit hour:
One credit hour is 1 hour of theory lecture or 3 hours of laboratory work in a week.
Degree plan
Following is the list of courses taught in the selected program. (Source Curriculum 2022)

Sr. #	Course Name	Course Code
01	Applied Physics	BS-105
02	Computing Fundamentals	EC-110
03	Fundamentals of Electrical Engineering	EE-220
04	Basic Biology	BS-100
05	Basic Mathematics	MT-100
06	Introduction to Biomedical Engineering	BM-101
07	Pakistan Studies	HS-102
08	Translation of the Quran: Beliefs	QT-101
09	Islamic Studies	IS-211
10	Calculus and Analytic Geometry	MT-101
11	Physiology I	BM-112
12	Electrical Network Analysis	EE-103
13	Object Oriented Programming	EC-112
14	Human Anatomy	BM-113
15	Complex Variables & Transforms	MT-201
16	Physiology II	BM-211
17	Biochemistry	BM-202
18	Basic Electronics	EE-200
19	Engineering Drawing	ME-211
20	Communication Skills	HS-103
21	Translation of the Quran: Worships	QT-201
22	Linear Algebra & Differential Equation	MT-205
23	Biomedical Electronics	BM-213
24	Digital Logic Design	EE-203
25	Biomechanics	BM-214
26	Signals and Systems	EE-206
27	Biomedical Instrumentation I	BM-311
28	Probability and Statistics	MT-302
29	Technical Report Writing	HS-201
30	Introduction to Microprocessor and Interfacing Techniques	EE-300
31	Biomedical Signal Processing	BM-312
32	Translation of the Quran: Moral Values	QT-301
33	Numerical Methods	MT-202
34	Biomedical Instrumentation II	BM-313
35	Biomedical Control Systems	BM-314
36	Elective-I	BM-XXX
37	Biomaterials	BM-315
38	Professional Values & Ethics	HS-401
39	Management and Entrepreneurship	HS-403
40	Medical Imaging	BM-411

41	Elective-II	BM-XXX
42	Elective-III	BM-XXX
43	Project Part-I	BM- 401
44	Translation of the Quran: Dealings and Commandments	QT-401
45	Foreign Language	HS-404
46	Elective-IV	BM-XXX
47	Modeling & Simulation	BM-400
48	Elective-V	BM-XXX
49	Project Part-II	BM-401
50	Economics	HS-402
51	Health Safety and Environment	ME-407

Curriculum Breakdown

Semester	Course Code	Credit Hours				
		Math and Basic Science		Core Courses	Humanities and Social Sciences	Technical Electives/ Other
		Math	Basic Science			
1	BS-105, EC-110, EE-220, EE-220L, BS-100, MT-100, BM-101, HS-102, QT-101	0	3	3	1	
2	IS-211, MT-101, BM-112, BM-112L EE-103, EE-103L, EC-112, BM-113, BM-113L	1		4	1	
3	MT-201, BM-211, BM-211L, BM-202 BM-202L, EE-200, EE-200L, ME-211 HS-103, QT-201		2	3	1	
4	MT-205, BM-213, BM-213L, EE-203, EE-203L, BM-214, BM-214L, EE-206, EE-206L	1		4		
5	BM-311, BM-311L MT-302, HS-201 EE-300, EE-300L BM-312, BM-312L HS-404, QT-301			4	1	
6	MT-202, BM-313 BM-313L, BM-314 BM-314L, BM-xxx BM-315, BM-315L HS-203		1	4		3
7	HS-401, HS-403 BM-411, BM-411L	1		4	1	6

	BM-XXX, BM-XXX BM- 401, QT-401					
8	BM-XXX, BM-400 BM-XXX, BM-401 HS-402, ME-407		2	4	1	6

Table 3: Curriculum Course Requirements (table 4.3)

Courses Information

4.1.1 Applied Physics (BS-105)

4.1.1.1 Objectives

To equip the students with the basic knowledge of common physical phenomenon relevant to biomedical engineering.

4.1.1.2 Books

1. David Halliday, Robert Resnick and Jearl Walker, WIE Fundamentals of Physics, 7th ed. 2005, John Wiley & Sons, ISBN:0471465097
2. Arthur Beiser, " Schaum's Outline of Applied Physics, 4th ed. 2004, McGraw-Hill, ISBN:0071426116
3. Hobbie, Russell, Intermediate physics for medicine and biology-4th edition, 2007

4.1.2 Applied Physics Lab (EE-105L)

4.1.2.1 List of practicals

1. Study of Hook's Law
2. Measuring stress, strain and Young's Modulus of different materials
3. Study of Surface Tension and Viscosity of liquids
4. Study of Boiling points of liquids
5. Study of Gas laws
6. Venturi effect of liquids in motion
7. Heat transfer and entropy
8. Study of light, Color addition, Refection and Prism
9. Measurement of Snell's Law
10. Convex and Concave Lens
11. Study of reversibility and Dispersion of Light
12. Focal point and Magnification of Thin lens
13. Focal point and Magnification of Concave Mirror
14. Telescope and Microscope
15. Calculation of speed of Sound
16. Project

4.1.3 Computer Fundamentals (EC-101)

4.1.3.1 Objective

To acquaint the students with the structure, operation, programming, and applications of computers.

4.1.3.2 Books

1. Brian Williams and Stacey Sawyer, Using Information Technology, Latest Edition, McGraw-Hill, ISBN: 0072260718
2. William Stallings, Computer Organization and Architecture: Designing for Performance, Latest Edition, Prentice Hall, ISBN: 0131856448, ISBN-13: 9780131856448
3. Allen Downey; Think Python: How to Think Like a Computer Scientist; Green Tea Press Needham, Massachusetts.
4. David Beazley and Brian K. Jones, “PYTHON Cookbook”; O'Reilly Atlas.

4.1.4 Fundamentals of Electrical Engineering (EE-220)

4.1.4.1 Objectives

To equip the students with the knowledge of Basics of electrical engineering.

Books

1. Basic Engineering Circuit Analysis, 8th Edition 2004 David Irwin ISBN-978-81-265-
2. S. Franco,” Electric Circuits Fundamentals” Oxford University Press, (Latest Edition).
3. R E Thomas, A J Rosa and G J Toussaint, “The Analysis and Design of Linear Circuits” John Wiley, 6th Edition, 2009
4. C Alexander and M Sadiku, “Fundamentals of Electric Circuits” McGraw- Hill 4th Edition, 2008

4.1.5 Fundamentals of Electrical Engineering Lab (EE-220L)

4.1.5.1 List of Practicals

1. To get familiar with the usage of dual power supply and multimeter.
2. To study the resistor color code and measure the value of given resistors by the resistor color code chart and also study about the potentiometer.

3. To study the properties of series circuit and also find the calculated value and measured values of the given resistors.
4. To study the properties of parallel circuit and also find the calculated value and measured values of the given resistors.
5. To solve the given combination (series-parallel) circuit and find the values given in the observation table.
6. To study the properties of combination (series-parallel) circuit and also solving the given circuits.
7. To study the properties of combination (series-parallel) circuit and also solving the given circuits.
8. To analyze the given circuit using superposition theorem and find out the value of voltage and current across Resistor.
9. To solve the given circuit using superposition theorem and find out the voltage and current.
10. To determine by analysis the values VTH and RTH in a DC circuit containing a single voltage source.
11. To verify Norton's Theorem and the theory of source Transformation.
12. To study the different switching method.
13. To study the characteristics of the transformer.
14. To perform open circuit and short circuit testing of a transformer
15. To study the characteristics and working principle of DC motor.
16. To study the different Relay switches.

4.1.6 Basic Mathematics (MT-100)

4.1.6.1 Objectives

To equip the student with the basic understanding of the several areas of mathematics.

4.1.6.2 Books

1. FSC Maths Part I / Part II

4.1.7 Basic Biology (BS-100)

4.1.7.1 Objectives

To equip the students with the knowledge of biology of human body, the role of enzymes in a human body and the function of DNA, RNA with respect to human body and the application of Biology in biomedical engineering.

4.1.7.2 Books

1. AS/A level Biology, Mary Jones, Contributors: Richard Fosbery, Jennifer Gregory, Dennis Taylor Edition 2, Cambridge University Press, 2007, ISBN 0521703069, 9780521703062

2. National Curriculum 2006, HEC Pakistan
3. FSC Biology Part I / Part II

4.1.8 Introduction to Biomedical Engineering (BM-101)

4.1.8.1 Objectives

To equip the students with the basic knowledge of Biomedical engineering and its applications with examples.

4.1.8.2 Books

1. Introduction to Biomedical Engineering, 4th Edition, John Enderle
2. Biomedical Engineering Handbook Volume I & II, J. D. Bronzino
3. AQA A-Level Biology, Pauline Lowrie, Mark Smith

4.1.9 Pakistan Studies (HS-102)

4.1.9.1 Objectives

To understand the historical perspective of Pakistan, the significant happenings that led to the creation of Pakistan, to know about constitutional and political developments in Pakistan. Understand about society, culture, land, people, economy and foreign policy of Pakistan.

4.1.9.2 Books

1. Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.National Curriculum 2006, HEC Pakistan
2. Zahid, Ansar. History & Culture of Sindh. Karachi: Royal Book Company, 1980.
3. Ziring, Lawrence. Enigma of Political Development. Kent England: Wm Dawson & sons Ltd, 1980.
4. Mehmood, Safdar. Pakistan Kayyun Toota, Lahore: Idara-e-Saqafat-eIslamia, Club Road, nd.

4.1.10 Islamic studies (IS-211)

4.1.10.1 Objectives

To equip the students with the knowledge of Basic information and understanding of Islamic principles and develop the skill of understanding of issues related to faith and religious life.

4.1.10.2 Books

1. Hameed ullah Muhammad, “Emergence of Islam” , IRI, Islamabad
2. Hameed ullah Muhammad, “Muslim Conduct of State”
3. Hameed ullah Muhammad, ‘Introduction to Islam
4. Mulana Muhammad Yousaf Islahi,”
5. Hussain Hamid Hassan, “An Introduction to the Study of Islamic Law” leaf Publication, Islamabad, Pakistan.
6. Ahmad Hasan, “Principles of Islamic Jurisprudence” Islamic Research Institute, International Islamic University, Islamabad (1993)
7. Mir Waliullah, “Muslim Jrisprudence and the Quranic Law of Crimes” Islamic Book Service (1982)
8. H.S. Bhatia, “Studies in Islamic Law, Religion and Society” Deep & Deep Publications New Delhi (1989)
9. Dr. Muhammad Zia-ul-Haq, “Introduction to Al Sharia Al Islamia” Allama Iqbal Open University, Islamabad (2001).

4.1.11 Calculus and Analytic Geometry (MT-101)

4.1.11.1 Objectives

Teach the concepts of calculus and analytic geometry and the applications of these concepts to the solution of engineering problems.

4.1.11.2 Books

1. George B. Thomas and Ross L. Finney, “Calculus and Analytic Geometry,” Latest Edition, Addison-Wesley, ISBN: 0201531747.
2. George F. Simmons, “Calculus with Analytic Geometry,” Latest Edition, McGraw-Hill, ISBN: 0070576424.
3. Gerald B. Folland, “Advanced Calculus,” Latest Edition, Prentice Hall, ISBN: 0130652652.
4. Monty J. Strauss, Gerald L. Bradley and Karl J. Smith, “Calculus”, Latest Edition, Prentice Hall, ISBN: 0130918717

4.1.12 Physiology-I (BM-112)

4.1.12.1 Objectives

To equip the students with the knowledge of fundamental concepts and methods of a life or physical science.

4.1.12.2 Books

1. Physiology for Engineers: Applying Engineering Methods to Physiological Systems (Biosystems & Biorobotics) [Michael Chappell and Stephen Payne], ISBN:978-3319261959.
2. Quantitative Human Physiology: An Introduction [Joseph J Feher], ISBN:978-0123821638
3. John E. Hall, Guyton and Hall Textbook of Medical Physiology, 13th Edition, ISBN: 9781455770052
4. Elaine N. Marieb, Essentials of Human Anatomy & Physiology, 11th Edition, ISBN: 9780321919007
5. Arthur B. Ritter, Physiology for Engineers: A Systems Approach, 2017, ISBN: 9781498734561

4.1.13 Physiology-I Lab (BM-112L)

4.1.13.1 List of Practical's

1. Use of stethoscope & measurement of human arterial blood pressure & pulse
2. Determination of Red Blood Cells per cmm of human Blood
3. Determination of White Cells per cmm of human blood
4. Determination of haemoglobin percentage in human blood
5. Physiochemical & microscope analysis of human urine sample (Renal System)
6. a) Demonstration of the use of ECG, b) Test of hearing
7. Determination of visual acuity of a human subject by using snellen's eye chart
8. Determination of bleeding time in human body
9. Determination of the coagulation time in human body

10. a) To record normal respiration & effect of System exercise on it using spirometer. b) To record normal respiration & effect of exercise on it using power lab. c) Introduction the organization & classification of neurons using neurolab System

11. To demonstrate the differential count of leukocytes in human blood Sample

12. To observe the shape of RBC in normal saline stem

13. To identify various parts of digestive tract & to observe cut mobility in exposed abdomen of dissected rabbit

14. To determine the group of blood sample.

4.1.14 Electrical Network Analysis (EE-103)

4.1.14.1 Objectives

To equip the students with the knowledge and techniques of electric circuit analysis.

4.1.14.2 Books

1. S. Franco, ”Electric Circuits Fundamentals” Oxford University Press, (Latest Edition).

2. R E Thomas, A J Rosa and G J Toussaint, “The Analysis and Design of Linear Circuits” John Wiley, 6th Edition, 2009

3. C Alexander and M Sadiku, “Fundamentals of Electric Circuits” McGraw- Hill 4th Edition, 2008

4.1.15 Electrical Network Analysis Lab (EE-103L)

4.1.15.1 List of Practical’s

1. To determine the voltage of series circuit
2. To determine the voltage of parallel circuit.
3. To determine the current through mesh analysis
4. To determine the voltage across nodes through nodal analysis of the circuit
5. To determine the voltage across nodes through nodal analysis of the circuit

6. To determine the voltage across Resistor in the circuit.
7. To study the filter circuit and response
8. To study the response of an RC circuit when applied with a sudden dc voltage source.
9. To study the response of a Driven RC circuit when applied with a sudden dc voltage source.
10. To Study the response of Parallel Resonant Circuit
11. To study the response of Series Resonant Circuit
12. To study source free RLC circuit and determine its response mathematically and graphically
13. To determine the transient analysis and plot transient analysis of RL circuit using PSpise
14. To determine the transient analysis and plot transient analysis of RLC circuit using PSpise.
15. Determine Natural Response of an RLC circuit.
16. To study source free RL circuit and determine its response mathematically and graphically

4.1.16 Object Oriented Programming (EC-112)

4.1.16.1 Objectives

This course gives a thorough grounding in the basics of Object Orientation

4.1.16.2 Books

1. Object-Oriented Programming in C++ (Latest Edition); Robert Lafore, publisher SAMs.
2. C++: The Complete Reference, (Latest Edition) by Herbert Schildt, publisher McGraw Hill.
3. C++ How to Program (Latest Edition) Edition by Paul Deitel, Harvey Deitel

4.1.17 Human Anatomy (BM-113)

4.1.17.1 Objectives

To equip the students with the basic principle structures of major human organs and systems.

4.1.17.2 Books

1. Medical Terminology: A Living Language (6th Edition) [Bonnie F. Fremgen and Suzanne S. Frucht], ISBN: 978-0134070254

2. New Biology for Engineers and Computer Scientists [Aydin Tozeren and Stephen W. Byers], ISBN: 978-0130664631
3. Gerard J. Tortora, Principles Of Human Anatomy, 13th Edition, ISBN: 9781118344996
4. B. D. Chaurasia, BD Chaurasia's Human Anatomy: Vol. 1, 6th Edition, ISBN: 9788123923307
5. Frederic H. Martini, Human Anatomy, 8th Edition, ISBN: 9780321883322
6. Elaine N. Marieb, Human Anatomy, 8th Edition, ISBN: 9780134243818

4.1.18 Human Anatomy Lab (BM-113L)

4.1.18.1 List of Practical's

1. Demonstration of Human Skeleton in general.
2. Demonstration of basic structures in Human Anatomy (Skin, Muscles & Other Structures).
3. Demonstration of Anatomical planes & positions.
4. Demonstration of Movements & Motinal Terms.
5. Demonstration & Study of Scapula & Clavicle.
6. Demonstration & Study of Humerus bone.
7. Demonstration of Ulna and Radius.
8. Demonstration of wrist & hand bones.
9. Demonstration of Pelvic bone.
10. Study and demonstration of Femur bone.
11. Study and demonstration of Tibia & Fibula.
12. Demonstration of Foot bones.
13. Demonstration of skull.
14. Demonstration & study of different parts of Vertebral column.
15. Study and Demonstration of different Models.
16. Audio & Visual Demonstration of Human Anatomy.

4.1.19 Complex Variables & Transforms (MT-201)

4.1.19.1 Objectives

To equip the students with the knowledge and techniques of various complex number systems and integral of complex functions including limits, continuity and differentiability of complex functions. Concepts in Laplace and Fourier transform and their transformation analysis.

4.1.19.2 Books

1. Erwin Kreyszig, Advance Engineering Mathematics, 10th Edition, ISBN: 9780470458365
2. Robert L. Borrelli and Courtney S. Coleman, Differential Equations: A Modeling Perspective, 2nd Edition, ISBN: 9780471433323

4.1.20 Physiology II (BM-211)

4.1.20.1 Objectives

To equip the students with the knowledge of human nervous system, motor functions and endocrinology. Differentiation of basic anatomical structures and functions related to the nervous system, reproductive and lymphatic system. Recognition of various physiological systems.

4.1.20.2 Books

1. Text book of Medical Physiology by Guyton and Hall (13th Edition).
2. Essential of Medical Physiology by Jaypee (6th Edition).
3. William F, “Review of Medical Physiology”.

4.1.21 Physiology II Lab (BM-211L)

4.1.21.1 List of Practical’s

1. Study of kymograph
2. Recording of simple muscle twitch in Gastrocnemius sciatic nerve preparation
3. Recording of the effect of two successive stimuli on the nerve muscle preparation

4. Recording of the effect of continuous stimuli (fatigue) in a nerve muscle preparation
5. To demonstrate phenomenon of tentanisation
6. Effect of temperature on the simple muscle twitch
7. Demonstrate the superficial reflexes on a given subject
8. Demonstrate the deep reflexes on a given subject
9. To observe the receptor adaptation associated with Paccinian Corpuscle and other receptors in a computer simulated program
10. To illustrate the principle of phase locking in auditory fibers by using the compute simulated program
11. Determination of visual field in human subject.
12. Observe and study the spectrum and waveforms of different vowels sound and their relationship with the configuration of the vocal tract
13. Study the movement in basilar membrane during the passage of sound waves of different frequencies, on a simulated mode
14. (a) To calculate nerve conduction velocity from twitch records obtained by using a nerve-muscle preparation using Kymograph. (b) To calculate nerve conduction velocity from twitch records obtained by using a nerve-muscle preparation using powerlab. To locate the gustoreceptors in the human
15. (a) To calculate nerve conduction velocity from twitch records obtained by using a nerve-muscle preparation using Kymograph. (b) To calculate nerve conduction velocity from twitch records obtained by using a nerve-muscle preparation using powerlab. To locate the gustoreceptors in the human
16. Demonstration of the recording of an (extracellular) action potential from frog sciatic nerve (monophasic & biphasic) on oscillograph / oscilloscope
17. Study of reflex movements in spine of frog; Effect of acid treatment, Effect Effects of electric shock & Effect of Strychnine.

4.1.22 Biochemistry (BM-202)

4.1.22.1 Objectives

To equip the students with the knowledge of biochemical and biophysical processes at molecular level. Comparison of metabolic pathways for the

diagnosis of metabolites in human body. Demonstration of amino acid separation using chromatographic methods. Finding out the blood glucose level with the help of spectrophotometer.

4.1.22.2 Books

1. Lippincott, Bio-Chemistry 5th Ed,2010 Donald Voet, Judith, G. Voel and Charlotte, W. Prats,
2. Fundamentals of Biochemistry, 2006, John Wiley & Sons. Rodney Boyer,
3. Modern Experimental Biochemistry, Pearsons Education, Delhi, India. Tsai. C. Stan,

4.1.23 Biochemistry Lab (BM-202L)

4.1.23.1 List of Practical's

1 How to prepare the Solution in Lab

2 Determination of pH by pH meter and Litmus paper

3 Demonstration the action of buffer

4 To determine the principle application of Hander son- Haselbash's equation

5 Tests for proteins

6 Examination of Egg white

7 Color reactions for proteins

8 Isolation of Casein from milk

9 Tests on carbohydrates

10 Measurement of Blood Glucose level with help of spectrophotometer

11 Oral Glucose Tolerance Test (OGTT)

12 Tests of Lipid profile by chemical analyzer

13 Separation of Amino Acids by chromatographic methods.

14 Open ended lab

4.1.24 Basic Electronics (EE-200)

4.1.24.1 Objectives

To equip the students with the knowledge and techniques of semiconductor devices. Express knowledge of primary electronic lab equipments. Investigate

the use of transistor and different passive electronic components in the development of certain electronic solutions with possible variations to fine tune the output.

4.1.24.2 Books

1. Electronic Devices and Circuit Theory By H. Boylestad and L. Nashelsky
2. Electronic Devices and Circuits By Theodore F. Bogart, Jr.

4.1.25 Basic Electronics Lab (EE-200)

4.1.25.1 List of Practical's

1 To observe the working of diode with forward and reverse bias.

2. Plot the diode characteristic curve.

3. Calculate the bulk resistance of the diode and observe its effect in the diode approximations.

4. To observe the working of half wave rectifier.

5. To observe the working of full wave rectifier

6. To observe the working of Bridge wave rectifier.

7. To observe the working of Zener Diode

8. To analyze the working of Clamper Circuit.

9. To analyze the working of Clipper Circuit.

10. To determine the output voltage for half wave and full wave voltage doubler.

11. To determine the output voltage for Zener limiting circuit

12. To use the transistor in switching mode.

13. Demonstrate the operation and determine the biasing parameter of Base Bias Circuit.

14. Demonstrate the operation and determine the biasing parameter of Voltage Divider Bias Circuit.

4.1.26 Engineering Drawing (ME-211)

4.1.26.1 Objectives

To equip the students with the knowledge of drawing skills and CAD drawings.

4.1.26.2 Books

1. A Textbook of Engineering Drawing: Along with an Introduction to AutoCAD (2015) by Roop Lal, Ramakant Rana
2. Mastering Autodesk Inventor 2015 and Autodesk Inventor LT 2015: Autodesk Official Press, Curtis Waguespack, ISBN: 978-1-118-86213-1
3. Engineering Drawing and Graphic Technology-International Edition, Thomas E. French, Charles J. Vierck, Robert J. Foster, McGraw-Hill, Inc.1993 ISBN 0-07-022347-5
4. Engineering Drawing and Design-Sixth Edition, C. Jensen, J.D. Helsel, D.R. Short, McGraw-Hill, 2002, ISBN 0-07-821343-6 (T 353 J47 2002)
5. Technical Drawing-Fourteenth Edition, F. E. Giesecke, A. Mitchell, H. C. Spencer, I.L. Hill, J.T. Dygdon, J.E., Novak, Prentice-Hall, Inc., 2012, ISBN 0-13-178446-3 (T 353 T43 2003)

4.1.27 Communication Skills (EE-103)

4.1.27.1 Objectives

To equip the students with the knowledge of verbal and non-verbal communication; components of communication; problems of communication; intercultural communication in the global context.

4.1.27.2 Books

1. Practical English Grammar by A. J. Thomson and A. V. Martinet. Fourth edition. Oxford University Press. ISBN 978-0-19-431342-1.
2. Practical English Grammar Exercises 1 by A. J. Thomson and A. V. Martinet. Third edition. Oxford University Press. ISBN 978-0-19-431349-0.
3. A Practical Guide to Business Writing: Writing in English for Non-Native Speakers by Khaled Mohamed Al Maskari. Wiley. ISBN 978 1 118 41079 0.

4.1.28 Linear Algebra & Differential Equation (MT-205)

4.1.28.1 Objectives

Introduce the matrix theory and the use of matrices in the solution of engineering problems.

4.1.28.2 Books

1. Gilbert Strang, "Linear Algebra and Its Applications", 4th Edition, Thomson Brooks/ Cole, 2007.
2. James M Ortega, "Matrix Theory – A Second Course", Plenum, 1991.
3. Otto Bretscher, "Linear Algebra with Applications", 3rd Edition, Prentice Hall, 2005.
4. David Poole, "Linear Algebra – A Modern Introduction", Brooks/Cole, 2003.

4.1.29 Digital Logic Design (EE-203)

4.1.29.1 Objectives

To equip the students with the knowledge of combinational and sequential circuits.

4.1.29.2 Books

1. M. Morris Mano and Micheal D. Ciletti, “Digital Design with an introduction to the Verilog HDL”, Prentice Hall, 5th Edition.
2. Morris Mano and Charles R. Kime, “Logic and Computer Design Fundamentals”, Prentice Hall. Latest Edition
3. Tocci and Widmer, "Digital Systems: Principles and Applications". Prentice Hall. Latest Edition

4.1.30 Digital Logic Design Lab (EE-203L)

4.1.30.1 List of Practical’s

1. Introduction to lab Equipment
2. Introduction to logic circuitry and Hardware implementation and verification of the truth tables of basic logic gates
3. Implementation of various functions using basic logic gates and verification by simulating using Verilog
4. Design a combinational circuit with four inputs A, B, C, and D and one output F.

5. To design and implement Half and Full Adders and verify by simulating in HDL.
6. (a) Design and implement Full Subtractor (b) Design circuit that convert BCD to Excess 3 code
7. To Investigate the operation of Encoders/Decoders.
8. Implementation of Multiplexer and De-Multiplexer.
9. (a) To understand and implement RS latches. (b) To implement and verify Flip Flop operations
10. (a) To implement binary counters. (b) To investigate the operation of synchronous 4-bit Up/Down counter
11. Simulate & Verify the behaviour of D, T & JK flip flop in Verilog.
12. To implement and study multivibrators using 555 timers IC.
13. To study shift register operations.
14. OPEN ENDED LAB

4.1.31 Biomedical Electronics (BM-213)

4.1.31.1 Objectives

To equip the students with the knowledge of single and multistage amplifiers. Analysis of various biomedical circuits using operational amplifiers. Designing and construction of data acquisition and signal conditioning circuits for biomedical applications.

4.1.31.2 Books

1. Electronics Design by Floyd 9th Edition
2. Operational amplifier and linear integrated circuits by Robert Coughlin

4.1.32 Biomedical Electronics Lab (BM-213L)

4.1.32.1 List of Practical's

1. Design and Analyze OP-AMP Based Inverting Amplifier
2. Design and Analyze OP-AMP Based Non-Inverting Amplifier
3. Design and Analyze the characteristics of Summing Amplifier
4. To study Characteristics of Differential Amplifier
5. To determine common mode rejection ratio (CMMR)
6. Design and Analyze OP-AMP Based Integrator
7. Design and Analyze OP-AMP Based Differentiator

8. Design and Analyze Instrumentation Amplifier
9. Designing an ECG Amplifier.
10. To Analyze Analog to Digital Converter
11. To Analyze Digital to Analog Converter
12. Designing and analyzing frequency response of Active Low Pass Filter
13. Designing and analyzing frequency response of Active High Pass Filter
14. Designing and analyzing frequency response of Active Band Pass Filter
15. Designing and analyzing frequency response of Active Band Stop Filter/
16. Project : ECG/EMG/ EOG/PPG Amplifier and filters

4.1.33 Biomechanics (BM-214)

4.1.33.1 Objectives

To equip the students with the knowledge of moving system mechanics and analyze the analytical problems related to human movements. Initiation of motion in upper and lower limbs using various biomechanical tools.

4.1.33.2 Books

1. Susan J. Hall, Basic Bio-Mechanics, 6th Ed, 2011.
2. Margareta Nordin, Victor H. Frankel, Basic Biomechanics of the Musculoskeletal System
3. NihatÖzkaya, et al, Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation
4. David A. Winter, Biomechanics and Motor Control of Human Movement

4.1.34 Biomechanics Lab (BM-214L)

4.1.34.1 List of Practical's

1. To determine the coordinates of the centre of gravity (COG) of a body using segmentation method.
2. To determine the centre of Gravity Measurement using Reaction Board
3. Volumetric analysis of irregular shaped body segments

4. To determine the muscle force required by the biceps while holding a known weight in hand for a range of elbow joint angles using the mechanical arm model
5. To determine the muscle force using an analytical model comprising two muscles at the elbow joint and compare the results with the previous one.
6. Design and develop a goniometer for upper limb.
7. Design and develop a goniometer for lower limb.
8. Design and develop a dynamometer for wrist.
9. Gait analysis among healthy individuals.
10. Dynamometry of human foot by virtue of body weight
11. Volumetric analysis of irregular shaped body segments
12. Analysis of human motion using Movement Velocity counter
13. Development of static human model using Visual 3D
14. Study of blood flow using blood vessel models
15. To design the human limbs on Solid works.
16. To analyse the human limbs on ANSYS.

4.1.35 Signals & Systems (EE-206)

4.1.35.1 Objectives

To equip the students with the knowledge of Signals and Systems classification, models, and operations; time domain analysis of continuous-time and discrete-time systems.

4.1.35.2 Books

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and Systems", 2nd Edition, Prentice Hall, 1996
2. M. J. Roberts, "Fundamentals of Signals and Systems", McGraw-Hill, 2007
3. B. P. Lathi, "Linear Systems and Signals", 2nd Edition, Oxford, 2004

4.1.36 Signals & Systems Lab (EE-206L)

4.1.36.1 List of Practical's

1. To be familiarize with the MATLAB and SIMULINK.
2. To plot the sinusoidal, exponential and singularity functions
3. To perform the time-shift, time-scaling and time-reversal operations on the signals
4. To compute and plot the impulse response of the system
5. To compute the convolution of LTI Systems
6. To find the Laplace-Transform and inverse Laplace transform of the system
7. To find the transfer function and system stability
8. To plot the signals spectra using Fourier transform
9. To plot the frequency response of the system
10. To design filter using Butterworth & Chebyshev techniques
11. Open ended lab 1
12. Open ended lab 2

4.1.37 Biomedical Instrumentation-I (BM-311)

4.1.37.1 Objectives

To equip the students with the knowledge of bio-potentials and biomedical sensors.

4.1.37.2 Books

1. Biomedical Instrumentation & Measures 2nd edition by Leslie Cromwell.1980. ISBN: 978-81- 203-0653-0.
2. Bioinstrumentation by John G. Webster.2004.ISBN: 978-81-265-1369-7
3. Medical Instrumentation: Application and Design by John G. Webster.4th ed, 2010. ISBN: 978-0-471-67600-3

4.1.38 Biomedical Instrumentation-I Lab (BM-311L)

4.1.38.1 List of Practicals

1. To study the principle of various Biomedical Transducer
2. To understand methods and instruments for body temperature measurement and compare temperature sensor for selection on the basis of their properties
3. To study the working of photo detectors/photo sensors and their application in biomedical
4. To study the techniques of measuring blood pressure and measure the systolic and diastolic pressure.
5. To become familiar with the electrocardiograph as a primary tool for evaluating electrical events within the heart and observe rate and rhythm changes in the ECG associated with body position and breathing.
6. To record maximum clench strength for right and left hands and correlate motor unit recruitment with increase skeletal force.
7. To record EMG response to increased weights lifted by dominant and non-dominant arms and to record EMG when fatigue is induced.
8. To observe respiratory cycle and record breath per minute and respiratory rate in different conditions eupnoea, hyperventilation and apnea Vera.
9. To record an EEG from an awake, resting subject with eyes open and eyes closed. Identify and examine alpha, beta, delta, and theta components of the EEG complex.
10. To record EOG on the horizontal plane and compare eye movements under the following conditions: pendulum tracking & pendulum simulation.
11. To observe respiratory cycle and record breath per minute and respiratory rate in different conditions eupnea, hyperventilation and apnea Vera.
12. To observe real time monitoring through multipara monitor/bedside monitor.
13. To Study the construction and working of x-ray equipment and to practice the safety aspect using standard procedure.
14. To practice the safety aspect of ultrasound machine using standard procedure
15. To observe the principle and working of ventilator.
16. Open ended lab 1

4.1.39 Probability and Statistics (MT-302)

4.1.39.1 Objectives:

To apply the concepts of probability and statistics on a dataset and to practice with different software tools.

4.1.39.2 Books:

1. Bernard Rosner, “Fundamentals of Biostatistics”, 7th Edition, Brooks/Cole Cengage Learning.
2. Wayne W. Daniel, “Biostatistics: A Foundation for Analysis in the Health Sciences”, 10th Edition, John Wiley & Sons, Inc
3. SPSS survival manual a step by step guide to data analysis using SPSS 4th edition by Julie Pallant.

4.1.40 Technical Report Writing (HS-201)

4.1.40.1 Objectives:

To know basics of technical report writing, research papers and report preparations.

4.1.40.2 Books

1. Patterns of College Writing (4th Edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin’s Press
2. The Mercury Reader. A Custom Publication. Compiled by Norther Illinois University. General Editiors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton.
3. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
4. College Writing Skills by John Langan. McGraw-Hill Higher Education. 2004

4.1.41 Introduction to Microprocessor & Interfacing Techniques (EE-300)

4.1.41.1 Objectives

To acquire fundamental knowledge/ features and operation of microcontroller/ microprocessor and its interfacing with the external world.

4.1.41.2 Books

1. Barry B. Brey, The Intel Microprocessor, 8th ed. 2009, ISBN-10: 0135026458

2. Roger L. Tokheim, Schaum's Outline of Theory and Problems of Microprocessor Fundamentals, Graw Hill Co., 1983, ISBN: 9780070649583

3. Douglas. V. Hall, Microprocessor and Interfacing, Programming and Hardware, Mc. Graw Hill Co., 1986

4. Scott Mackenzie, “The 8051 Microcontroller”, Prentice Hall, ISBN: 0-13-780008-8

5. Muhammad Ali Mazidi, PIC Microcontroller and Embedded Systems, Pearson’s Prentice Hall, 20085. Chung Yau Lam “Applied Numerical Methods for the Solution of Partial Differential Equations”

6. Dr Saeed Akhtar Bhatti “A First Course in Numerical Analysis”.

7. John L. Van Iwaarden “Ordinary Differential Equations with Numerical Techniques”.

4.1.42 Introduction to Microprocessor & Interfacing Techniques Lab (EE-300L)

4.1.42.1 List of Practicals

1. To demonstrate the hardware of microcontrollers and microprocessor
2. To use Proteus and Multisim simulating software for simulation
3. To use Keilmicro vision software for assembly and c programming
4. To generate List and Hex files
5. To interface and simulate ports of microcontroller (General)
6. To interface and simulate LEDs
7. To interface and simulate seven segments
8. To interface and simulate monochrome LCD
9. To program and perform ADC
10. To program and perform DAC
11. To connect external memory elements with microcontroller
12. To program and perform DC motor interfacing and PWM
13. To program and perform serial communication (RS232)
14. To program and perform parallel communication (RS232)

4.1.43 Biomedical Signal Processing (BM-312L)

4.1.43.1 Objectives

To understand different techniques for power spectrum processing and its application on bio-signals.

4.1.43.2 Books

1. Biomedical Signal Analysis, 2nd Ed, Ranagaraj M. Rangayyan, ISBN: 978-0-470-91139-6, Willey- IEEE Press.
2. Biomedical Signal Analysis: Contemporary methods and Applications, Fabian J, Theis and Anke Meyer, The MIT Press Cambridge, Massachusetts.
3. Biomedical Signal Processing: Principles and Techniques. D. C. Reddy.
4. Fundamentals of Digital Signal Processing. by: Joyce Van de Vegte.
5. Digital Signal Processing: Fundamentals and Applications. by: Li Tan, 2nd Edition.

4.1.44 Biomedical Signal Processing Lab (BM-312L)

4.1.44.1 List of Practicals

1. Impulse and Step Responses
2. Convolution and Correlation
3. Z-transform, Pole-Zero Plot, Stability
4. Frequency response analysis
5. Frequency spectra analysis
6. FIR filter design
7. IIR Filter Design
8. Analysis of Filter behavior
9. Filter simulation
10. PPG Signal Analysis. Signal Peaks. Peak widths. Heart rate. SpO2
11. ECG Waveform Analysis.
12. EEG Processing
13. Feature Extraction from EEG Signals.
14. Sound Processing. Detecting cardiac condition from digital stethoscope

4.1.45 Numerical Methods (MT-202)

4.1.45.1 Objectives

To solve the engineering problems by analytical means.

4.1.45.2 Books

1. Dunn, Stanley M, Alkis Conastantinides, Numerical Methods in Biomedical Engineering 2006
2. Canal and Chapra “Numerical Methods for Engineers”.
3. Curits F. Gerald “Applied Numerical Analysis”.
4. Erwin Kreyszig “Advanced Engineering Mathematics”.
5. Chung Yau Lam “Applied Numerical Methods for the Solution of Partial Differential Equations”
6. Dr Saeed Akhtar Bhatti “A First Course in Numerical Analysis”.
7. John L. Van Iwaarden “Ordinary Differential Equations with Numerical Techniques”.

4.1.46 Biomedical Instrumentation II (BM-313)

4.1.46.1 Objectives

To study in-vitro diagnosis and analysis of human samples by microscopes, spectroscopes and various chemicals to identify diseases.

4.1.46.2 Books

1. Mary C. Haven (Editor), et al, Laboratory Instrumentation, 4th ed, 1995. ISBN: 978-81-265
2857-8
2. Cromwell, Bio-Medical Instrumentation & Measures 2. 2nd ed,1980. ISBN: 978-81-203-0653-
3. John G. Webster (Editor), Medical Instrumentation 2. 2nd ed. 2010. ISBN: 978-0-471-67600

4.1.47 Biomedical Instrumentation II Lab (BM-313L)

4.1.47.1 List of Practicals:

1. Demonstration and Troubleshooting of centrifuge
2. Separation of Blood components using Centrifuge
3. Hemoglobin separation using Electrophoresis.
4. Design and Development of Virtual Instruments in Lab View.
5. Introduction to Virtual Instrument Designing in Lab View
6. Building Applications using For loops in Lab View
7. Signal Processing using Lab View
8. Analysis of Cerfiximetrihydrate using UV Spectrophotometer.
9. Determination of absorption coefficient using UV-spectrophotometer.
10. Wavelength analysis of different light sources using Atomic Spectrometer.
11. Demonstration and working of High-Performance Liquid Chromatography (HPLC)
12. Demonstration and working of Hematology Analyzer.
13. Demonstration and working of Chemistry Analyzer
14. Troubleshooting and repair of Medical Equipment
15. Comprehension of documentation and hospital set-up
16. Open Ended Lab 1

4.1.48 Biomedical Control Systems (BM-314)

4.1.48.1 Objectives

To study basic principles of control engineering and its applications to find the stability of the system.

4.1.48.2 Books

1. Control Systems Engineering, by: Norman S. Nise, 7th Edition.
2. Modern Control Engineering, by: Katsuhiko Ogata, 5th Edition.
3. Biomedical Applications of Control Engineering, by Selim S. Hacısalihzade

4.1.49 Biomedical Control Systems Lab (BM-314L)

4.1.49.1 List of Practical's

1. To be familiar with the MATLAB programming and control system toolbox.
2. Find the closed-loop transfer function of the system.
3. To find the impulse and step responses of the control system.
4. To compute the transient response parameters of control systems.
5. To find the partial fraction residues and poles of the system.
6. To find the Eigen values of the system.
7. Transfer function to state space conversion.
8. To find the closed-loop pole locations to check the stability of the system.
9. To obtain the root locus of the system.
10. To obtain the Bode plot of the system.
11. To plot the Nyquist diagram of the system.
12. To find the gain and phase margins of the system
13. Open ended lab 1
14. Open ended lab 2

4.1.50 Biomaterials (BM-315)

4.1.50.1 Objectives

To study different properties of biomaterials for the designing of medical implants.

4.1.50.2 Books

1. Buddy D. Ratner, et al, Biomaterials Science, Second Edition: An Introduction to Materials in Medicine
2. Handbook of Biomaterial Properties (Second Edition) edited by William Murphy, Jonathan Black, Garth Hastings.
3. Michael N. Helmus (Editor), Biomaterials in the Design and Reliability of Medical Devices
4. David Hill, Design Engineering of Biomaterials for Medical Devices
5. Jos Vander Sloten (Editor), Computer Technology in Biomaterials Science and Engineering (Biomaterials Science & Engineering)

6. Kay C. Dee, et al, An Introduction to Tissue-Biomaterial Interactions
7. Joon B. Park, Joseph D. Bronzino, Biomaterials Principles and Application
8. Xian, Wujing, A laboratory course in biomaterials, 2009.
9. Mahapatro, Anil, Polymers for biomedical applications, 2008.
10. Temenoff, J. S, Biomaterials: The intersection of biology & materials science, 2008.

4.1.51 Biomaterials Lab (BM-315L)

4.1.51.1 List of Practicals:

1. To build molecular model of a biopolymer from basic repeating peptide units
2. Molecular graphics of basic repeating units of biopolymer
3. Interpretation of bio X-ray diffraction of a biomaterial expected diffraction pattern
4. Calculate R-value for structural analysis of biopolymers
5. To build model of CHITOSAN (bio-materials) from basic repeating units.
6. Molecular graphics of basic repeating units of CHITOSAN.
7. Demonstration of features of dental chair & dental operatory.
8. Demonstration of bio-materials (bioceramics, porcelain & metals) its composition & properties
9. Demonstration of the process of sterilization, autoclave & X-ray unit (dental).
10. Separation of bio-material (protein) by electrophoresis method involved in various diseases.
11. Demonstration of different types of sutures.
12. Fabricate a biomaterial for bone tissue
13. Fabricate a biomaterial for dental tissues
14. Tension and compression analysis for fabricated biomaterials.
15. Open ended lab 1

4.1.52 Community Service (HS-203)

4.1.52.1 Objectives

It is a 45hours contact program 15 hours of tutoring on Disaster Management, Community health, Leadership & Social Skills, First Aid, Traffic Awareness etc. followed by 30 hours student work directly in the fields on their chosen project related to environment, education, health, community building, etc.

4.1.53 Professional Values & Ethics (HS-401)

4.1.53.1 Objectives

To acquire basic knowledge of Professional Practices and ethics in the domain of biomedical engineering and its application in planning engineering projects.

4.1.53.2 Books

1. Evans, J.R. & Lindsay, W.M., The Management and Control of Quality, 2011, 8th Edition, West Publishing, ISBN9780538452601.

2. White, M.A. and Bruton, G.D., The Management of Technology, 2006, Thomson South Western, ISBN: 0-234-3565-0

3. Meredith & Mantel, Project Management - A Managerial Approach, 2014, 9th Ed, Prentice Hall, ISBN: 978-1-118-94583-4.

4.1.54 Management & Entrepreneurship (HS-403)

4.1.54.1 Objectives

To analyze the theories of entrepreneurship and to go for case studies of successful entrepreneurs. Students are expected to develop analytical and conceptual framework of how people are managed in small, medium and large public and private national and international organizations.

4.1.54.2 Books

1. Stephen P. Robins, Mary Coulter: Management
2. H. Koontz Odonnel and H. Weihrich: Management

3. Mc Farland: Management: Foundation and Practice
4. Robert M. Fulmer: The New Management.
5. Paul Burns and Jim Dew Hurst: Small Business and Entrepreneurship
6. P.N. Singh: Entrepreneurship fo0r Economic Growth
7. Peter F. Drucker: Innovation and Entrepreneurship Peter F. Drucker
8. John B. Miner: Entrepreneurial Success

4.1.55 Medical Imaging (BM-411)

4.1.55.1 Objectives

To study different principles and technologies based upon radiological equipment.

4.1.55.2 Books

1. Bushberg J.T., The Essential Physics of Medical Imaging 3rd Ed.
2. Z. H. Cho, Foundations of Medical Imaging
3. Biomedical Imaging (Principles & Application Engg: Series).
4. Digital Image Processing for Medical Applications, Geoff Dougherty, Cambridge University Press 978-0-521-86085-7

4.1.56 Medical Imaging Lab (BM-411L)

4.1.56.1 List of practicals

1. Demonstration of X-rays Equipment
2. Demonstration of X-ray Tube components
3. Demonstration of the X-ray collimator, Grids, and Filters
4. Demonstration of Ultrasound Equipment and differentiate between contrast
5. Ultrasound of liver and Gallbladder
6. Ultrasound of spleen
7. Ultrasound of kidney
8. Ultrasound of pancreas
9. Visualization of MRI images

10. Demonstration of CT Scan images of the cerebral aneurysm

11. Demonstration of MRI images of the Brain Tumors and discuss the related issues

12. Demonstration of MRI images of the Knees and discuss the related issues13. Demonstration of the fluoroscopic images of the blood flow through the arteries

14. Demonstration of the PET Scans

15. To understand the difference between PET and MRI and CT scan

16. Open ended lab 1

4.1.57 Foreign Language (HS-404)

4.1.57.1 Objectives

To communicate effectively in the foreign language in different situations.

4.1.58 Modeling & Simulation (BM-400)

4.1.58.1 Objectives

To study the concepts of basic mathematical, electrical, fluidic models and its analogous systems for the analysis of research problems by stimulating the physiological models.

4.1.58.2 Books

1. Modeling and simulation in biomedical engineering, Willem Van Meurs.
2. Physiological Modeling: An Introductory Course for Biomedical Engineers , John Enderle
3. Advances in Numerical Heat Transfer, Volume 3, W. J. Minkowycz.
4. Introduction to Modeling in Physiology and Medicine, Claudio Cobelli and Ewart Carson
5. Modeling and Simulation in Medicine, Frank C. Hoppensteadt, Charles S. Peskin,

4.1.59 Modeling & Simulation Lab

4.1.59.1 List of Practicals

1. Introduction to modeling using software
2. Design of conceptual model
3. Modeling of cardiovascular system
4. Simulation of Bio heat equation
5. Modeling and simulation of blood flow
6. Modeling and simulation arterial plaque
7. Modeling heat transfer through skin
8. Modeling of electrical stimulation
9. Modeling of human organs
10. Heat simulation using RF coil and high intensity focused ultrasound
11. Modeling through medical images
12. Simulation of light propagation in the eye
13. Glucose and insulin regulation model.
14. Renal clearance modeling using compartmental model
15. Skin Absorption Model using Ficks's Law

4.1.60 Economics (HS-402)

4.1.60.1 Objectives

To gain an understanding of core economic principles and how they apply to a wide range of real-world issues.

4.1.60.2 Book

1. Contemporary Engineering Economics by Chan S. Park, 6th edition, Pearson 2015, ISBN: 978- 0134105598 2.
2. Engineering Economic Analysis by Donal G. Newnan, Jerome P. Lavelle, Ted G. Eschenbach, 12th edition, Oxford University Press, ISBN: 978-0199339273
3. Engineering Economy by Leland T. Blank and Anthony Tarquin

4.1.61 Health Safety & Environment (ME-407)

4.1.61.1 Objectives

The Health Safety and Environment course is specifically designed to provide environmental protection and safety at work. It involves generating organized procedures and efforts in order to identify different types of hazards. It aims to reduce accidents at workplaces. Students of engineering program will learn how to identify different types of hazards like ergonomic, thermal, chemical, electrical and radioactive hazards at workplaces, which can affect the health and safety of employees. Students will learn about the management of hazardous materials and wastes. This course will address specific threats, such as outdoor and indoor air pollution, toxic metals, pesticides and radiation. Emphasis will also be given to understanding the worsening environmental health impacts of industrialization on developing countries, the effects of globalization, such as the growing movement of hazardous industries, products, and wastes across borders and the rise of the environmental justice movement.

4.1.61.2 Books

1. Health and Safety, Environment and Quality Audits: A Risk-based Approach by Stephen Asbury
2. Health and Safety in Construction Revision Guide: For the NEBOSH National Certificate in Construction Health and Safety by Ed Ferrett.

4.1.62 Bioelectricity (BM-446)

4.1.62.1 Objectives

To equip the students with the knowledge of bio-electrical phenomena and electrical stimulation and their applications.

4.1.62.2 Books

1. Applied Bioelectricity From Electrical Stimulation to Electropathology by Reilly, J. Patrick.
2. Transcutaneous Electrical Nerve Stimulation (TENS): Research to support clinical practice by Mark I. Johnson

4.1.63 Power Electronics (BM-445)

4.1.63.1 Objectives

To equip the students with the knowledge of modern semiconductor devices and their switching and protection methods. Operation of power converters, applications motor drives, and evaluate suitable converter types of a given application.

4.1.63.2 Books

1. N. Mohan, T. M. Undeland, and W. P. Robbins, Power Electronics: Converters, Applications, and Design, Media Enhanced 3rd Edition, John Wiley & Sons, Inc., 2003.
2. M. H. Rashid, Power Electronics: Circuits, Devices, and Applications, 4th Edition, Prentice Hall, 2014.
3. M. D. Singh and K.B. Khanchandani, 'Power Electronics', Tata McGraw-Hills Publishing Company Limited, 2nd Edition, 2006.
4. Power Electronics--A First Course" Mohan, Wiley.
5. Vedam Subramaniam, 'Power Electronics', New Age International (P) Ltd Publishers, 2001.
6. Philip T. Krein, 'Elements of Power Electronics', Oxford University Press, 1st Edition, 2012.
7. V.R.Moorthi, 'Power Electronics-Devices, Circuits and Industrial Applications', Oxford University Press, 1st Edition, 2005.

4.1.64 Rehabilitation Engineering (BM-444)

4.1.64.1 Objectives

To equip the students with the knowledge of limb Prosthetic devices, orthotic devices, devices for visually impaired, and devices for hearing Impairment.

4.1.64.2 Books

1. Rory A Cooper and Hisaichi Ohnabe, An Introduction to Rehabilitation Engineering, 2006, ISBN: 9780849372223
2. Pedro Encarnação and Albert Cook, Robotic Assistive Technologies: Principles and Practice, 2017, ISBN: 9781498745727

3. Marko B. Popović, Biomechanics and Robotics, 2013, ISBN: 9789814411370
4. Albert M. Cook and Janice Miller Polgar, Assistive Technologies: Principles and Practice, 4th Edition, ISBN: 9780323096317
5. Kevin Russell Henderson, Wheelchairs: Perceptions, Technology Advances and Barriers, 2016, ISBN: 9781536103908
6. Michelle M. Lusardi, Orthotics and Prosthetics in Rehabilitation, 3rd Edition, ISBN: 9781437719369

4.1.65 Medical Robotics (BM-443)

4.1.65.1 Objectives

To equip the students with the knowledge of robots, solve mathematically the position and orientation of objects and the relationship between robot joint coordinates and tool position. Differentiate types and characteristics of actuators, control systems and operating interface of medical robots. Recognize different movements of kinematics. Make robotic arm with sensor actuation.

4.1.65.2 Books

1. Robotics: Everything You Need to Know About Robotics from Beginner to Expert, Peter Mckinnon (Paperback– January 28, 2016)
2. Robotics, Vision and Control: Fundamental Algorithms in MATLAB, 2011
3. Springer Handbook of Robotics, Siciliano, Bruno, Khatib, Oussama, 2008
4. Robotics Modelling, Planning and Control, Siciliano, B.,Sciavicco, L., Villani, L., Oriolo, 2009.
5. Medical Robotics: Minimally Invasive Surgery, Paula Gomes, ISBN:9780857097392, 2012
6. Medical Robotics, Schweikard, Achim, Ernst, Floris, 2015.

4.1.66 Biofluid Mechanics & Bioheat Transfer (BM-421)

4.1.66.1 Objectives

To equip the students with the knowledge of Biofluid Mechanics & Bioheat Transfer and Analysis of the cardiovascular system.

4.1.66.2 Books

1. Biofluid Mechanics, An Introduction to Fluid Mechanics, Macrocirculation, Microcirculaltion, David Rubenstein, 2nd Edition
2. Nano and Bio Heat Transfer and fluid flow, Majid ghassemi, 1st Edition, 2017.

4.1.67 Bioinformatics (BM-430)

4.1.67.1 Objectives

To equip the students with the knowledge of fundamentals of GENOMICS AND TRANSCRIPTOMICS with respect to bioinformatics. structure, classification and functions of protein & DNA. Compare protein sequences.

4.1.67.2 Books

1. Introduction to Bioinformatics, Arthur M. Lesk, 4th Edition, Oxford University Press, 2014, ISBN 0198724675, 9780198724674
2. Bioinformatics and Functional Genomics, Jonathan Pevsner, 2nd Edition, Wiley, 2009, ISBN 0470085851, 9780470085851.

4.1.68 Artificial Intelligence (BM-433)

4.1.68.1 Objectives

To equip the students with the knowledge of artificial intelligence with emphasize on search algorithms and the concept of AI agents.

4.1.68.2 Books

1. Russell S.; Norvig P.; “Artificial intelligence – A Modern Approach”, Latest Edition, Prentice Hall.
2. Luger G.F.; Artificial Intelligence – Structures and Strategies for Complex Problem Solving”, Latest Edition, Pearson Higher Education.

4.1.69 Hospital Information System (BM-436)

4.1.69.1 Objectives

To equip the students with the knowledge of concepts, components and applications of Hospital Information System (HIS). Latest developments in Hospital Management and Information Systems. Benefits of Electronic Health Records (EHRs) and use of Decision Support Systems (DSS) in HIS.

4.1.69.2 Books

1. Strategic Information Management in Hospitals: An Introduction to Hospital by Reinhold Haux ISBN:0-378-40356-6
2. Medical Data Management: A Practical Guide ISBN 978-0-387-21773-4.

4.1.70 Medical Device Quality Systems and Standards (BM-441)

4.1.70.1 Objectives

To equip the students with the knowledge of medical device quality system standard.

4.1.70.2 Books

1. A Complete Guide to Quality Management in the Medical Device Industry, ItayAbuhav.

4.1.71 Medical Image Processing (BM-435)

4.1.71.1 Objectives

To equip the students with the knowledge of fundamentals of Medical Image Processing techniques (spatial domain, frequency domain, noise removal, image reconstruction and image segmentation).

4.1.71.2 Books

1. Digital Image Processing for Medical Applications by Geoff Dougherty, Cambridge University Press.
2. Digital Image Processing by Gonzales, R. C., Prentice Hall, New Jersey.

4.1.72 Telemedicine Systems (BM-434)

4.1.72.1 Objectives

To equip the students with the knowledge of Telemedicine Systems and applications, rudiments of a Telemedicine systems. Demonstration of medical devices networking by exploiting the concepts of IOT.

4.1.72.2 Books

1. Bernard Fong, ACM Fong, CK Li “Telemedicine Technology: Information Technologies in Medicine and Telehealth” 2011 ISBN: 978-0-470-74569-4.

2. Norris A. C, “Essentials of Telemedicine & Telecare”, 2001 ISBN: 0-471-53151-0

3. Marlene Maheu, Ace Allen, Pamela Whitten, “E-Health, Telehealth & Telemedicine”: A guide to startup and success. ISBN: 0787944203

4. B.S Chowdhry & Faisal Abro, “Telemedicine Modernization & Expansion of Healthcare System”. ISBN: 969-86-80-00-4.

4.1.73 Biophysics (BM-420)

4.1.73.1 Objectives

To equip the students with the knowledge of biophysics as an interdisciplinary research field, structure and functions of biological system from molecular to system level.

4.1.73.2 Books

1. V. Pattabhi, N. Gautham, Biophysics, Kluwer Academic Publications.

2. Principles of Physical Biochemistry Book by K. E. Van Holde, Prentice-Hall International.

3. Physiology, Biophysics, and Biomedical Engineering (Series in Medical Physics and Biomedical Engineering), Andrew W Wood-CRC Press (2012)

4. Paul, Davidovitis, Physics in Biology & Medicine, 3rd Ed, 2007

4.1.74 DNA Computing (BM-425)

4.1.74.1 Objectives

To equip the students with the knowledge of computational methods for simulating biological macromolecules, dynamics of DNA, quantum in bioinformatics.

4.1.74.2 Books

1. D. Frankel and B. Smit "Understanding Molecular Simulations: From Algorithms to Applications"
2. T. E. Creighton "Proteins" (2nd edition, W.H. Freeman, and Co., New York).

4.1.75 Drug Delivery Systems (BM-427)

4.1.75.1 Objectives

To equip the students with the knowledge of Drug diffusion, drug dispersion, Drug Permeation, Drug Transport, Drug delivery systems, the ethical obligations applied in controlled drug delivery systems.

4.1.75.2 Books

1. Drug Delivery: Engineering Principles for Drug Therapy by Saltzman; Oxford University Press.

4.1.76 Genetic Engineering (BM-423)

4.1.76.1 Objectives

To equip the students with the knowledge of gene manipulation and Medical and forensic applications and analyze the different PCR techniques.

4.1.76.2 Books

1. An Introduction to Genetic Engineering, 3rd Edition. Desmond S. T. Nicholl, Cambridge University Press
2. Recombinant DNA: Genes and Genomes - A Short Course, 3rd Edition, Cold Spring Harbor Laboratory Press.

4.1.77 Neuroscience (BM-428)

4.1.77.1 Objectives

To equip the students with the knowledge of mechanism involved in the transmission of information in the brain, modulation of brain function, role of neuro transmitters for various diseases and the role of signaling pathways for their associated neurons.

4.1.77.2 Books

1. Progress in Neuroscience, Readings from Scientific American, John Wiley.
2. Philip, G. Srauge, Brain Biochemistry and Brain Disorders, Oxford Press.
3. George, J. Siegal, B. W. Agranoff, S. K. fisher , M. D. Uhler, Basic Neurochemistry: Molecular, Cellular and Medical Aspects, Lippincott D. Uhler.
4. Darakhshan Haleem, Neurochemistry, Neuropharmacology and Behavior, 2010.
5. Mark F. Bear, Barry W. Connors & Michael A. Paradiso, Neuroscience: Exploring the brain, 2006.

4.1.78 Regenerative Medicine (BM-426)

4.1.78.1 Objectives

To equip the students with the knowledge of mechanism of cell regeneration, basics of stem cells, cloning, therapeutic use of stem cells and tissue regeneration using hormones and apply the principles of tissue engineering and regenerative medicine to design an artificial organ in theory.

4.1.78.2 Books

1. Kay C. Dee, et al, An Introduction to Tissue-Biomaterial Interactions
2. Advances in Regenerative Medicine, Edited by Sabine Wislet-Gendebien, ISBN 978-953-307-732-1
3. Rolando Barbucci (Editor), Integrated Biomaterials Science
4. Temenoff, J. S, Biomaterials: The intersection of biology & materials science, 2008.
5. Tissue Regeneration - From Basic Biology to Clinical Application, Edited by Jamie Davies, ISBN 978-953-51-0387-5

6. Regenerative Medicine and Tissue Engineering - Cells and Biomaterials, Edited by Daniel Eberli, ISBN 978-953-307-663-8.

4.1.79 Tissue Engineering (BM-422)

4.1.79.1 Objectives

To equip the students with the knowledge of general understanding in the field of tissue engineering. The basics of tissue and biomaterial interaction, biocompatibility, biodegradable, bioreactor, cell culture, cell proliferation, extracellular matrix and growth factors. To design a specific biological tissue with respect to its function, mechanical property and biocompatibility.

4.1.79.2 Books

1. Buddy D. Ratner, et al, Biomaterials Science, Second Edition: An Introduction to Materials in Medicine
2. Handbook of Biomaterial Properties (Second Edition) edited by William Murphy, Jonathan Black, Garth Hastings.
3. David Hill, Design Engineering of Biomaterials for Medical Devices.
4. Jos Vander Sloten (Editor), Computer Technology in Biomaterials Science and Engineering (Biomaterials Science & Engineering)
5. Kay C. Dee, et al, An Introduction to Tissue-Biomaterial Interactions
6. Temenoff, J. S, Biomaterials: The intersection of biology & materials science, 2008.
7. Tissue Regeneration - From Basic Biology to Clinical Application, Edited by Jamie Davies, ISBN 978-953-51-0387-5.

4.1.80 Computational Fluid Dynamics (BM-431)

4.1.80.1 Objectives

To equip the students with the knowledge of theoretical basis of computational fluid dynamics. Demonstrate CFD model for “real world” engineering, complex problems using CFD. Develop computational models

and their results and to write a report conveying the result of the computational analysis.

4.1.80.2 Books

1. J.Y. Tu, G.H. Yeoh, and C. Liu, Computational Fluid Dynamics: A Practical Approach, 2nd Edition, 2012.
2. H.K. Versteeg and W. Malalasekera, An introduction to Computational Fluid Dynamics. The Finite Volume Method, 2nd Edition
3. J.D. Anderson, Computational Fluid Dynamics.
4. P.J. Roache, Fundamentals of Computational Fluid Dynamics.
5. P.J. Roache, Verification and Validation in Computational Science and Engineering.
6. J.C. Tannehill, D.A. Anderson and R.H. Pletcher, Computational Fluid Mechanics and Heat Transfer.
7. S.V. Patankar, Numerical Heat Transfer and Fluid Flow.
8. D.C. Wilcox, Turbulence modelling for CFD. All of the above textbooks can be found in the UNSW.

4.1.81 Nano Biotechnology (BM-424)

4.1.81.1 Objectives

To equip the students with the knowledge of applications of nanotechnology and its interdisciplinary aspect. Understand principles governing the effect of size on material properties at the nanoscale, and perform quantitative analysis and nanotechnology techniques.

4.1.81.2 Books

1. Brydson, R. M.; Hammond, C., Generic Methodologies for Nanotechnology: Classification and Fabrication. In Nanoscale Science and Technology, John Wiley & Sons, Ltd: 2005; pp 1-55.
2. Brydson, R. M.; Hammond, C., Generic Methodologies for Nanotechnology: Characterization. In Nanoscale Science and Technology, John Wiley & Sons, Ltd: 2005; pp 56-129.

3. Leggett, G. J.; Jones, R. A. L., Bionanotechnology. In Nanoscale Science and Technology, John Wiley & Sons, Ltd: 2005; pp 419-445.
4. Bucke, C., Bionanotechnology—lessons from nature. By David S Godsell. Wiley-Liss, Hoboken, NJ, 2004. 352 pp, ISBN 0 471 41719 X. Journal of Chemical Technology & Biotechnology 2005, 80 (8), 964-965.
5. Goodsell, D. S., In Bionanotechnology, John Wiley & Sons, Inc.: 2004; pp i-xii.
6. Gibbs, M. R. J., Nanomagnetic Materials and Devices. In Nanoscale Science and Technology, John Wiley & Sons, Ltd: 2005; pp 203-236.
7. Gerrard, J. A., Protein Nanotechnology: Protocols, Instrumentation, and Applications, Second Edition. Humana Press: Totowa, NJ, 2013.
8. Marie, R.; Kristensen, A., Nanofluidic devices towards single DNA molecule sequence mapping. Journal of Biophotonics 2012, 5 (8-9), 673-686.

4.1.82 Medical Device Regularity Affairs (BM-442)

4.1.82.1 Objectives

To equip the students with the knowledge of major global reference regulations and harmonization efforts formedical devices, regulatory environment in key Asian markets for medical devices, general pre-market requirements, the legal logics behind the definition and regulation of advanced products.

4.1.82.2 Books

1. Medical Product Regulatory Affairs: Pharmaceuticals, Diagnostics, Medical Devices by John J. Tobin, Gary Walsh, ISBN: 978-3-527-31877-3
2. Handbook of Medical Device Regulatory Affairs in Asia by Jack Wong, Raymond Tong Kaiyu.

Standard 2-1

The curriculum must be consistent and support the program's documented objectives.

4.6.1 Group 1: Electrical and Computer Engineering

EC-112 Object oriented Programming, EC-110 Computing Fundamentals, EE-220 Fundamentals of Electrical Engineering, EE-103 Electrical Network Analysis, EE-200 Basic Electronics, EE-203 Digital Logic Design, EE-206 Signals and Systems, EE-300 Introduction to Microprocessor and Interfacing Techniques,

4.6.2 Group 2 General Sciences

BS-105 Applied Physics, BM-202 Biochemistry, BS-100 Basic Biology,

4.6.3 Group 3 Biomedical Engineering

BM-101 Introduction to Biomedical Engineering, BM-112 Physiology-I, BM-113 Human Anatomy, BM-211 Physiology-II, BM-213 Biomedical Electronics, BM-214 Biomechanics, BM-311 Biomedical Instrumentation-I, BM-312 Biomedical Signal Processing, BM-313 Biomedical Instrumentation-II, BM-314 Biomedical Control Systems, BM-315 Biomaterials, BM-411 Medical Imaging, BM-400 Modeling & Simulation, BM-420 Biophysics, BM-421 Biofluid Mechanics & Bioheat Transfer, BM-422 Tissue Engineering, BM-423 Genetic Engineering, BM-424 Nano Biotechnology, BM-425 DNA Computing, BM-426 Regenerative Medicine, BM-427 Drug Delivery Systems, BM-428 Neuroscience, BM-430 Bioinformatics, BM-431 Computational Fluid Dynamics, BM-432 Medical Data System, BM-433 Artificial Intelligence, BM-434 Telemedicine Systems, BM-435 Medical Image Processing, BM-436 Hospital Information System, BM-440 Biomedical Engineering Systems, BM-441 Medical Device Quality and Standards, BM-442 Medical Device Regularity Affairs, BM-443 Medical Robotics, BM-444 Rehabilitation Engineering, BM-445 Power Electronics, BM-446 Bioelectricity.

4.6.4 Group 4 Humanities

HS-102 Pakistan Studies, IS-211 Islamic Studies, HS-103 Communication Skills, HS-201 Technical Report Writing, HS-404 Foreign Language, ME-407 Health Safety and Environment, HS-401 Professional Values & Ethics.

4.6.5 Group 5: Mathematical Sciences

MT-100 Basic Mathematics, MT-101 Calculus and Analytical Geometry, MT-205 Linear Algebra and Differential Equations, MT- 201 Complex variable and Transforms, MT-302 Probability and Statistics, MT-202 Numerical methods.

4.6.6 Group 6: Projects

Design and Implementation Projects

Course Groups and Program Objectives

Courses Groups	Objectives			
	1	2	3	4
1		✓		
2		✓		
3	✓	✓	✓	
4				✓
5		✓		
6	✓	✓	✓	✓

Table: Courses versus Program Objectives

Standard 2-2

Theoretical backgrounds, problem analysis and solution design must be stressed within the program's core material.

Elements	Courses
Theoretical Background	BM-101 Introduction to Biomedical Engineering, BM-112 Physiology-I, BM-113 Human Anatomy, BM-211 Physiology-II, BM-213 Biomedical Electronics, BM-214 Biomechanics, BM-311 Biomedical Instrumentation-I, BM-312 Biomedical Signal Processing, MT-101 Calculus and Analytical Geometry, MT-205 Linear Algebra and Differential Equations
Problem Analysis	BM-313 Biomedical Instrumentation-II, BM-314 Biomedical Control Systems, BM-400 Modeling & Simulation, BM-313 Biomedical Instrumentation-II, BM-314 Biomedical Control Systems, BM-315 Biomaterials, BM-411 Medical Imaging, BM-430 Bioinformatics, BM-442 Medical Device Regularity Affairs, MT-

	101 Calculus and Analytical Geometry, MT-205 Linear Algebra and Differential Equations.
Solution Design	BM-421 Biofluid Mechanics & Bioheat Transfer, BM-422 Tissue Engineering, BM-423 Genetic Engineering, BM-424 Nano Biotechnology, BM-425 DNA Computing, BM-426 Regenerative Medicine, BM-427 Drug Delivery Systems, BM-431 Computational Fluid Dynamics, BM-432 Medical Data System, BM-433 Artificial Intelligence, BM-435 Medical Image Processing, BM-436 Hospital Information System, MT302 Probability and Statistics

Table 5: Standard 2-2 Requirement (table 4.5)

Standard 2-3

The Curriculum must satisfy the core requirements for the program as specified by the respective accreditation body.

BS Biomedical Engineering (Communication) program is accredited by the Pakistan Engineering Council (PEC) and has no deviation from PEC requirements. Minimum Requirements for each program (Program Semester Credit Hours)

Program	Maths & General Sciences	Engineering Topics (Biomedical)	General Education (Humanities & Management Sciences)	Others (Computer Sciences)	Electives
BS Biomedical Engineering	20	89	20	9	

Table 6: Program Credit Hours

Standard 2-4

The curriculum must satisfy the major requirements for the program as specified by the respective accreditation body.

Same as Standard 2-3.

Standard 2-5

The curriculum must satisfy general education, arts and professional and other discipline requirements for the program as specified by the respective accreditation body.

Same as standard 2-3 and Standard 2-1 (table 6) as defined above.

Standard 2-6

Information technology component of the curriculum must be integrated throughout the program

Semester 1 contains the 3 credit hours of information technology topics (Computing Fundamentals), out of which 2 credit hours are for theoretical work and 1 credit hour is for laboratory work. This course covers basic computer programming concepts and logic, thus enhancing student's learning capability regarding computers, hardware and software to support their engineering learning and research.

Semester 2 contains the 3 credit hours of information technology topics (Object Oriented Programming), out of which 2 credit hours are for theoretical work and 1 credit hour is for laboratory work. This course introduces students to object oriented programming by teaching concepts of program specification, design, coding and testing using a modern software development environment. This course will help students to identify and practice the use of C++ classes and class libraries, develop their own C++ classes for a number of application scenarios covered during the course.

Standard 2-7

Oral and written communication skills of the student must be developed and applied in the program.

3 credit hours subject Communication Skills in 3rd semester and 3 credit hours subject Technical Report Writing in 5th semester, are taught to develop the oral and written communication skills of the students.

5.0 Criterion 3: Laboratories and Computing Facilities

HITEC University has established multiple laboratories for students to practice their learning outcomes. Following is the list of available laboratories:

1. Applied Physics Lab
2. Bioelectronics Lab
3. Biomechanics Lab

The details about these laboratories are provided on the following pages:

Laboratory Title	Applied Physics Lab	Bioelectronics Lab	Biomechanics Lab
Location & Area	Israr Block(2nd Floor)	Israr Block(2nd Floor)	Israr Block (2nd Floor)
Objectives	Provides students with facility of practicing the use of software, for acquiring and visualizing Biomedical parameters.	Provides students with hardware facility to grasp and develop their reasoning of the use of electronics for Biomedical Parameters.	Provides students with different Software and hardware equipment to simulate, acquire and process various Biomedical Parameters.
Adequacy for Instruction	All required instructions are displayed in the lab at appropriate places for use by faculty, students and support staff.	All required instructions are displayed in the lab at appropriate places for use by faculty, students and support staff.	All required instructions are displayed in the lab at appropriate places for use by faculty, students and support staff.
Courses Taught	1. Applied Physics	1. Biomedical Electronics	1. Biomechanics 2. Signal and systems 3. Electrical Network Analysis
Software Available	MS Office, MATLAB, PASCO	MS Office, MATLAB, MS Visio,Pspice,	MS office, MATLAB, Pspice, PASCO
Major Apparatus / Equipment	• Computers • Basic optic system • Weight machine • Resonance Tube • PASCO Hooke's law • Simple Hooke's law • Basic Calorimetry meter • Desktop Computers • LCD monitor	• Oscilloscopes • Function Generators • DC Power Supply • Digital Storage Oscilloscope • Digital Multi meter • Power Supply • Wire Cutter • Tweezers • Screw driver • Wire Stripper • Galvanometer • Nose Plyer • Analog Lab Trainer Module	• PASCO Human Arm Structures • PASCO Human Leg Structures • PASCO Human Back Structures • Human Arm Model • Center of Gravity • Materials testing machine • BIOPAC Data Acquisition Set • Force plates (Wireless 2-axis Force Platform) • Goniometers • Computers • LCD monitors

		• Glue gun • Extension Board	
Safety Regulations	Safety regulations are being strictly followed. See Annex I for details of Laboratory Precautions.	Safety regulations are being strictly followed. See Annex I for details of Laboratory Precautions.	Safety regulations are being strictly followed. See Annex I for details of Laboratory Precautions.

5.1 Standard 3-1

Laboratory manuals/documentation/instructions for experiments must be available and easily accessible to faculty and students.

All manuals and instructions are available in the respective Laboratory and copies of these are also available in BME coordinator office. Faculty members and students can easily access the lab manuals from the laboratory assistants. HITEC University has state of the art laboratories equipped with fine equipment and can easily meet the growing standards of the world.

5.2 Standard 3-2

There must be support personal for instructions and maintaining the laboratories.

Each laboratory has 2 staff members; 2 laboratory assistant and a laboratory attendant.

Laboratory assistant is responsible for overall maintenance of laboratory and also maintains the manuals and instructions while laboratory attendant is responsible to maintain the laboratory equipment and general duties within the lab.

5.3 Standard 3-3

The University computing infrastructure and facilities must be adequate to support program's objectives.

The computer laboratories are equipped with state of the art computers and relevant equipment. The program objectives require the students to be equipped with IT skills at the end of the program and facilities (equipment and software) provided in the computer laboratories are adequate enough to achieve program objectives.

6.0 Criterion 4: Student Support and Advising

Since the launch of HITEC University in year 2007, all its programs have started and finished on schedule. The culture in HITEC is that teachers and students have facility of frequent interaction, even after classes, for any professional and academic advice. This aspect is even highlighted and indicated by the students in the feedback on HEC Performa number 10, taken by the QEC in the university.

Standard 4-1

Courses must be offered with sufficient frequency for students to complete the program in a timely manner.

The department strategy to offer courses (core and electives) for the subject program is based on schedule approved by Pakistan Engineering Council (PEC), given in university prospectus. The required and elective courses are offered in a logical sequence that grooms the students to obtain the program's defined objectives and outcomes. The courses offered outside the department belongs to department of Electrical Engineering, department of Mathematics and department of Computer Science and Engineering. The Engineering program coordinator, collaborates with the respective department coordinators and accommodate the desired courses in program's time table. This is done well in advance prior to the commencement of classes to avoid any clashes in the schedule.

Standard 4-2

Courses in the major area of study must be structured to ensure effective interaction between students, faculty and teaching assistants.

Courses are structured in the board of studies before commencement of each semester. Faculty members interact frequently among themselves and with students. Contact hours for students to visit the respective faculty members are also displayed. Students are encouraged to participate in providing feedback and their views about course contents during and after the course.

Standard 4-3

Guidance on how to complete the program must be available to all students and access to qualified advising must be available to make course decisions and career choices.

Students are informed about the program requirements at the start of the session during orientation week by chairman of the department. Chairman acts as advisor to guide students to choose appropriate courses and also provide guidance on different issues. He also maintains a list of guidance points provided to students during the semester. These points are evaluated at the end of the program to take necessary improvement.

Director student's affair provides professional counseling to students as per need. Students can get in touch directly with him/her for any advice.

Director student affairs and senior faculty members arrange industrial tours for students to improve their subject vision and technical knowledge. They also invite professionals from different industries to conduct interactive sessions with students for advice on professional matters and future career planning.

Program coordinator maintains a list of professional societies and technical bodies, which is provided to students on demand. Students can get membership of such organizations on individual basis.

7.0 Criterion 5: Process Control

Standard 5-1

The process by which students are admitted to the program must be based on quantitative and qualitative criteria and it should be clearly documented. This process must be periodically evaluated to ensure that it is meeting its objectives.

The program has a well-defined admission criterion, which includes evaluation of students' previous education and admission test results. Admissions are entertained annually in fall semester.

Students who have scored more than 60% marks in SSC and HSSC examination (pre-engineering and pre-medical group) or A levels or equivalent with Physics, Chemistry and Mathematics/Biology or Diploma of Associate Engineering in relevant field, are eligible to appear in the admission test of the program. Admission is granted strictly on the basis of academic record and admission test results.

Students from accredited universities are eligible to transfer their credits to HITEC University. Students have to submit complete course curriculum and internal evaluation certificate of each subject from his/her previous institution duly signed by head of the department/principal. Student's applications in this regard are dealt on case to case basis. Such applications are discussed in Board of Studies for evaluation and decision. Controller of examination is the final authority to make decision regarding credit transfers.

This admission criterion is reviewed annually by the board of faculties and academic council in the light of instructions issued by PEC and HEC. Minor adjustments are made under those recommendations.

Standard 5-1

The process by which students are registered in the program and monitoring of students' progress to ensure timely completion of the program must be documented. This process must be periodically evaluated to ensure that it is meeting its objectives.

On completion of admission process including deposit of dues, the applicants will be registered as students of the University. Applicants are

required to provide original academic certificates and documents to the Registrar Office at the time of registration. After registration, Registrar Office will issue registration number and university registration card to all students.

Students are evaluated through quizzes, assignments, case studies/ seminars/workshops, practical/laboratory tests, semester projects and final year projects. In addition, there are two sessional examinations (per semester) and a final examination carrying weightage of 30% and 50% respectively. The performance of each student in a course of study is based on relative grading system, mentioned below;

Grade	Grade Point
A	4.00
A-	3.67
B+	3.33
B	3.00
B-	2.67
C+	2.33
C	2.00
C-	1.67
D	1.00
F	0.00
I	Incomplete

Only qualified students, based upon above mentioned criterion, in each semester are eligible to pick courses for the next semester. We are currently working to develop an evaluation system to periodically check the significance of this whole process.

Standard 5-3

The process of recruiting and retaining highly qualified faculty members must be in place and clearly documented. Also processes and procedures for faculty evaluation and promotion must be consistent with institution mission statement. These processes must be periodically evaluated to ensure they meet the objectives.

Vacant and newly created positions are advertised in the national newspapers. Applications are received by the Registrar office, scrutinized by the respective head of departments. Call letters are issued to the short-listed candidates on the basis of experience, qualification, publications and other qualities/activities as determined by the University in the light of HEC guidelines. Before appearing in the interview the short listed candidates have to present their work in front of senior faculty members. The candidates are interviewed by the University Selection Board comprising of head of department, dean engineering, vice chancellor, treasure and registrar. Induction of new candidates depends upon the number of approved vacancies.

Faculty members are retained by giving them good remuneration, favorable teaching environment, research facilities and management support. The teaching responsibilities are reasonable to let faculty members focus on research and innovation. Research work published in renowned journals is awarded monetary support. To retain highly qualified faculty, on campus family accommodation is provided to PhD qualified faculty members. Schooling facility is provided to children of faculty members, the first kid is taught at HITEC School for free and second child for 75% fee.

On yearly basis faculty performance is evaluated as per HEC Performa number 10; head of department's recommendations and with the counter signature of vice chancellor. The annual increment is based on the recommendations of the Dean and the vice chancellor.

7.4 Standard 5-4

The process and procedures used to ensure that teaching and delivery of course material to the students emphasizes active learning and that course learning outcomes are met. The process must be periodically evaluated to ensure that it is meeting its objectives.

The program is actively evaluated by Dean, Chairperson of the department and QEC department. The feedback of the subject taught is the best instrument to measure that the course outcomes were

compatible with the course objectives. The students give feedback on Performa number 1 regarding course contents and its delivery. Through Performa number 10, students evaluate and comment on teacher's efforts, to deliver the course contents, his/her general conduct in the class, the environment he/she maintains and extra efforts, he/she makes to satisfy students' quest for knowledge.

Faculty feedback is also received on HEC Performa number 2 (Faculty Course Review Report – Annexure L) and Performa number 5 (Faculty Survey – Annexure - G) which is a very useful activity to evaluate the course contents, learning and teaching environment and overall teacher's satisfaction level. Course evaluation by teachers also indicates what percentage of desired outcome has been achieved by the course contents and what needs to be improved or changed.

This exercise is repeated every semester. The feedback is discussed with Chairperson, who focuses on making improvements in the weak areas, identified by the students. Each teacher is graded out of 5 marks. The grades indicate level of performance of teachers, as visualized by the students. QEC formally submits these feedback results to VC, Dean Engineering and Technology and Chairman for their information and for necessary corrective measures.

7.5 Standard 5-5

The process that ensures that graduates have completed the requirements of the program must be based on standards, effective and clearly documented procedures. This process must be periodically evaluated to ensure that it is meeting its objectives.

The program is being run on semester basis and at the end of each semester examinations are held to evaluate the student's progress. Qualified students are allowed to join next semester and this cycle continues till the end of 8th semester which is the final semester. At the end of the 8th semester all students will be required to submit their respective final year projects. Student's final results will be announced on the basis of projects and examination results.

Requirements of this standard are met through three Performa issued by HEC. The feedback is documented and its evaluation indicates degree of satisfaction of the graduates. The first of these Performa is Performa 3 i.e. Survey of Graduating Students (Annexure-F). Second Performa is Perform 7 i.e. Alumni Survey (Annexure-A) and third Performa is Performa 8 i.e. Employer Survey (Annexure-B). These mentioned Performa are extremely good instruments to measure the program outcomes.

The process of feedback collection from employer will come in action once the students graduate and are employed. All the above mentioned survey's will be conducted after the graduation of first batch of biomedical engineering.

8.0 Criterion 6: Faculty

8.1 Standard 6-1

There must be enough full time faculties who are committed to the program to provide adequate coverage of the program areas/courses with continuity and stability. The interests and qualifications of all faculty members must be sufficient to teach all courses, plan, modify and update courses and curricula. All faculty members must have a level of competence that would normally be obtained through graduate work in the discipline. The majority of the faculty must hold a Ph.D. in the discipline.

Program Area of Specialization	Courses in the area and average number of sections per year	Number of faculty members in each area	Number of faculty with PhD Degree
Biomedical	BM-311, BM-312, BM-313, BM-314, BM-315, BM-411, BM-400, BM-420, BM-423, BM-426, BM-431, BM-434, BM-337, BM-442, BM-445, BM-448,	4	1
Total	**16**	**4**	**1**

Table 11: Faculty Distribution by Program Area

8.2 Standard 6-2

All faculty members must remain current in the discipline and sufficient time must be provided for scholarly activities and professional development. Also, effective programs for faculty development must be organized.

Faculty concurrency in the discipline is determined based on the criterion set by the University in accordance with HEC guidelines. All faculty members submit their professional resumes on HEC Performa number 9 (Faculty Resume) once a year (Annexure-H). This information is compared with the existing criterion set by university for the concurrency of the post.

All full time faculty members are allocated teaching hours as per HEC defined limit, which enables the faculty to have enough spare time to perform scholarly activities. All faculty members allocate separate work hours for discussion and interaction with students.

Faculty members are provided with adequate resources for research and academic activities. Faculty members also have access to library materials for academic and research activities. Professional training is also provided to faculty to enhance their capabilities. A training workshop is organized for faculty members in summer to improve their method of teaching and critical thinking.

Special arrangements are made by the department to facilitate faculty participation in professional development courses. Recently, university has organized training workshop titled, ‘Quality Assurance in Education’ for senior faculty members who will then mentor junior faculty members. The university encourages the faculty to participate in research activities by providing them sufficient financial support within or outside university, to publish in conferences and journals.

8.3 Standard 6-3

All faculty members should be motivated and have job satisfaction to excel in their profession.

Faculty members are motivated through documented appreciation (annual performance evaluation report) in addition to faculty recreational tours funded by university and interdepartmental sports events.

The faculty survey of the program using HEC Performa number 5 indicates the mix reactions of the faculty, which indicates that teaching load be distributed evenly and more relaxed environment be generated. Faculty Survey results are attached in Annexure G.

9.0 Criterion 7: Institutional Facilities

9.1 Standard 7-1

The institution must have the infrastructure to support new trends in learning such as e-learning.

The university has provided e-learning facilities to faculty members and students. All faculty members and students have access to internet and e-learning library section through LAN and wireless.

A separate team from within the IT Department is working to maintain and improve system for supporting e-learning. The team is adequately staffed, and is well trained and capable of providing on the spot support. The university has provided enough funding to support the e-learning based on Moodle software.

A total of 25 desktop computer systems are available to students, in the library, to access electronic library resources. Also, university website supports a Moodle system for easy access of students to the lectures and other course related material.

A Content Management System (CMS) is used to handle student's attendance and semester results in a collaborative environment. The team is also working to integrate fee payments and admission processes into the CMS.

9.2 Standard 7-2

The library must possess an up-to-date technical collection relevant to the program and must be adequately staffed with professional personnel.

The university library has enough technical books in hard copies to support the program learning. Online library management system helps faculty to search the required books and manage books that are already issued to them.

The library is staffed with 3 professional staff members and 2 para-technical staff and 4 non-technical staff members. Total 9 staff members are working in 2 shifts (Morning and Evening) to help students and

faculty members to get access to required book or learning material efficiently.

9.3 Standard 7-3

Class-rooms must be adequately equipped and offices must be adequate to enable faculty to carry out their responsibilities.

The department has sufficient number of class rooms to accommodate all sessions as per university schedule. All class rooms are equipped with air conditioners to provide a good working environment, with proper lighting and ventilation. Most class rooms also have fixed/portable multimedia resources.

Faculty offices are sub-divided into cubicles to maintain privacy and to provide a noise free environment, which will enable faculty members to focus on research activities. Each faculty office is equipped with air conditioner, printer and internet connectivity. Administrative department helps maintain the infrastructure and perform regular repair and maintenance.

10.0 Criterion 8: Institutional Support

10.1 Standard 8-1

There must be sufficient support and financial resources to attract and retain high quality faculty and provide the means for them to maintain competence as teachers and scholars.

University allocates enough financial resources each year to hire competent faculty as required. A research fund of worth Rs. 500,000 had been created to support faculty supervised final year projects.

As already listed in standard 5-3, faculty members are retained by giving them good remuneration, favorable teaching environment, research facilities and management support. On premise residence is provided to PhD qualified faculty and there is a plan to build a faculty hostel.

As listed in standard 6-2, faculty members are provided with adequate resources for research and academic activities to maintain their competence. Faculty members have also access to library materials for academic and research activities. Professional training is provided to faculty not only to enhance their capabilities, but also resulting in career growth.

.

10.2 Standard 8-2

There must be an adequate number of high quality graduate students, research assistants and Ph.D. students.

The university follows the guidelines of PEC for admission in this program. The number of graduate students given admission during the last three years is 73, including two PhD students. Currently there are no research assistants in the department.

Faculty to graduate student's ratio for the last three years remained in the range of 3:1 to 9:1.

10.3 Standard 8-3

Financial resources must be provided to acquire and maintain Library holdings, laboratories and computing facilities.

Library at HITEC University holds more than 16423 books for all programs. The library provides number of computers for supporting student learning. Library is organized to accommodate more than 60 students (male, female) in the library commons. The computers in the library commons are equipped with internet facility.

Laboratories at HITEC University are adequately stocked with equipment and supporting material which enable students to carry out the desired experiments and laboratory work. Each year a fixed amount of budget is allocated to each laboratory to maintain and upgrade the equipment and other facilities.

Computing facilities provide excellent platform to students to enhance their learning capabilities. There are 2 computer laboratories, which are fully equipped for providing IT related infrastructure support.

11.0 Conclusion

The self-assessment report of the Department of Biomedical Engineering, HITEC University is an important document, which gives strengths and weaknesses of the program. The management is striving hard to improve infrastructure for establishment of conducive environment for studies. The faculty is focused on imparting quality education, introducing innovative techniques for conducting quality research to produce competent engineers. The report has been prepared after evaluating the program in the light of 8 criterions and 31 standards given in HEC's Self-Assessment Manual. The program mission objectives and outcomes are assessed and strategic plans are presented to achieve the goals, which are again measurable through definite standards. Teachers' evaluation revealed satisfactory standards, the score of 14 teachers of the program ranged from 3.48 to 4.32. Students' course evaluation score ranged between 3.48 and 4.32 with a mean of 3.74 points in 0-5 scale. Improvements in curriculum design and infrastructure are suggested which are based upon set, well defined and approved criteria. Examinations are held according to fixed schedules, academic schemes are prepared well in advance, transparent admission, registration and recruiting policy, excellent student teacher ratio are some of the strong areas of this program. The number of courses along with titles and credit hours for each semester are thoroughly planned. Their efficacy was measured through different standards and it was found to be satisfactory. The need of refresher courses for the fresh faculty on methods of teaching cannot be over emphasized.

Proper steps are taken to guide the students for program requirements, communication, meetings, tutorial system, tours, students-teacher interaction etc. Some improvements have been suggested regarding the process control covering admission, registration, recruiting policy, courses and delivery of material, academic requirements, performance and grading. The university, Pakistan Engineering Council as well as Higher Education Commission have set forth proper rules, which are properly followed. At present there are 4 faculty members who are highly qualified in their fields. However, faculty

members need motivation for advanced knowledge, research and external training.

Institutional facilities were measured through Criterion 7; infrastructure, library, class room and faculty offices and in each case, short comings and limitations are highlighted. Institutional facilities need to be strengthened. Accordingly, institutional support will greatly promote and strengthen academic, research, management and leadership capabilities.

In conclusion, the strong and weak areas of the program are as under:

11.1 Strong Areas

- Curriculum Design, development and organization are based upon set, well defined and approved criteria
- Pre-requisites fully observed
- Examinations according to fixed schedule.
- Academic schemes fully prepared in advance
- The number of courses along with their titles and credit hours for each semester, course contents for degree program are fully planned
- Transparent admission, registration and recruiting policy
- PEC and HEC guidelines are fully followed
- Excellent students-teacher ratio
- Efficient and capable senior faculty

11.2 Weaknesses

- Low percentage of design contents in syllabi
- Low number of case studies
- Training of junior faculty members

Annexure – A: Research Papers List

Year 2015

1. Aamir Razaq, M.H Asif, Riffat Kalsoom, Ather Farooq Khan, M.S Awan, S, Ishrat, Shahid M. Ramay, “CONDUCTIVE AND ELECTROACTIVE COMPOSITES PAPER REINFORCED BY COATING OF POLYANILINE ON LIGNOCELLULOSIC FIBERS”, JOURNAL IN APPLIED POLYMER SCIENCE, (2015) 132, 42293(1-5)

Year 2017

2. Daniyal Younas, Quart-ul-ain Javed, Sabeen Fatima, Riffat Kalsoom, Hussain Abbas, Yaqoob Khan, “DRUDE CONDUCTIVITY EXHIBITED BY CHEMICALLY SYNTHESIZED REDUCED GRAPHENE OXIDE”, MATERIALS RESEARCH EXPRESS, (2017) 4.
3. N. Nizam-Uddin and I. Elshafiey, "Enhanced Energy Localization in Hyperthermia Treatment Based on Hybrid Electromagnetic and Ultrasonic System: Proof of Concept with Numerical Simulations," BioMed Research International, vol. 2017 p. 18, 2017.
4. N. Nizam-Uddin, W. Alkadri, W. A. Malik, I. Elshafiey, and A. F. Sheta, "Towards Wideband Hyperthermia Treatment System," Applied Computational Electromagnetics Society Journal, vol.32, pp. 769-780, 2017.
5. N. Nizam-Uddin and I. Elshafiey, "Enhanced Energy Localization with Wideband Hyperthermia Treatment System," Applied Computational Electromagnetics Society Journal, vol. 32, pp. 389-396, 2017.

Year 2018

6. M. Shafique, A. Naeem, “Design and development of an efficient and cost effective ECG simulator capable of generating normal and pathological ECG signals" in International Journal of Simulation, systems, science and technology, 2018
7. N. Nizam-Uddin and I. Elshafiey, Efficient energy localization for hybrid wideband hyperthermia treatment system.," International Journal of RF and Microwave Computer-Aided Engineering, e21238, 2018

Year 2019

8. M. A. Abid, I. Khan, Z. Ullah, K. Ullah, A. Haider and S. M. Ali, "Dielectric and Thermal Performance Up-Gradation of Transformer Oil Using Valuable Nano-Particles," in IEEE Access, vol. 7, pp. 153509-153518, 2019, doi: 10.1109/ACCESS.2019.2948959.

Year 2020

9. N. Nizam-Uddin and I. Elshafiey, Toward a Multi-Target Multi-Channel Hyperthermia Treatment System: Proof of Concept with Numerical Simulations, International Journal of Heat and Mass Transfer, 2020

Year 2021

10. W. Alkadri, N. Nizam-Uddin, I. Elshafiey, and A. F. Sheta, “Towards an Efficient Chipless RFID System for Modern Applications in IoT Networks”, Appl. Sci. 2021, Appl. Sci. 2021, 11(19), 8948,
11. F. Humayun, A. Khan, S. Ahmad, W. Yuchen, G. Wei, N. Nizam-Uddin, “Abrogation of SARS-CoV-2 interaction with host (NRP1) Neuropilin-1 receptor through high-affinity marine natural compounds to curtail the infectivity: A structural-dynamics data, Computers in Biology and Medicine, https:// doi.org/10.1016/j.compbiomed.2021.104714.
12. Abbas Khan, Jianjun Gui, Waqar Ahmad, Inamul Haq ,N. Nizam-Uddin “The SARS-CoV-2 B.1.618 variant slightly alters the spike RBD–ACE2 binding affinity and is an antibody escaping variant: a computational structural perspective”, RSC Adv.,2021,11,30132,
13. Khan, Abbas, Shahzeb Khan, Shoaib Saleem, N. Nizam-Uddin, Anwar Mohammad, Taimoor Khan, Sajjad Ahmad et al. "Immunogenomics guided design of immunomodulatory multi-epitope subunit vaccine against the SARS-CoV-2 new variants, and its validation through in silico cloning and immune simulation." Computers in Biology and Medicine 133 (2021): 104420.
14. Khan, A., Wei, D.Q., Kousar, K., Abubaker, J., Ahmad, S., Nizam-Uddin, N., Sayaf, A.M. and Mohammad, A., Preliminary Structural Data Revealed that the SARS-CoV-2 B. 1.617 Variant’s RBD binds to ACE2 receptor stronger than the Wild Type to Enhance the Infectivity. ChemBioChem 2021.
15. Zeb, Adnan, Syed Shujait Ali, Abul Kalam Azad, Muhammad S uleman, N. Nizam-Uddin, Abbas Khan, and Dong-Qing Wei. "Genome-wide screening of vaccine targets prioritization and reverse vaccinology aided design of peptides vaccine to enforce humoral immune response against jejuni." Computers in Biology and Medicine 133 (2021): 104412.
16. Ahmad, Namra, Syed Shujait Ali, Muhammad Suleman, Shahid Ali, N. Nizam-Uddin, Abbas Khan, and Dong-Qing Wei. "Computational Modeling of Immune Response Triggering Immunogenic Peptide Vaccine Against Cervical Cancer." Viral Immunology (2021).
17. I. Khan, M. A. Abid, K. Ullah et al. "Multi-aging Effects on Vegetable Based Oils for Transformer Insulation in HV Systems. " J. Electr. Eng. Technol. 16, 2709–2720 (2021).

Year 2022

18. N. Nizam-Uddin, W. Alkadri, I. Elshafiey, and A. F. Sheta, “Towards an Efficient System for Hyperthermia Treatment of Breast Tumors”, Biomedical Signal Processing and Control, August 2022

Year 2023

19. Abdulkawi, W.M.; Masood, A.; Nizam-Uddin, N.; Alnakhli, M. A Simulation Study of Triband Low SAR Wearable Antenna. Micromachines 2023, 14, 819. https://doi.org/10.3390/mi14040819

Annexure – B: Faculty Resume

Sr. No.	Name	Designation	Details of Qualifications		Specialization	Experience Teaching (Total) Years	Dedicated / Shared
			Degree	Institution			
1	Dr. Nizam ud Din	Assistant Professor & Head of Department	Ph.D.	King Saud University, KSA	Biomedical	13	Dedicated
			MS	Edinburgh Napier University, UK	Electronics		
			BS	UET Peshawar	Electrical		
2	Engr. Ayesha Naeem	Lecturer	MS	Riphah International	Biomedical	03	Dedicated
			BS	Riphah International	Biomedical		
3	Engr. Muhammad Ahtasham	Lecturer	MS	COMSATs Abbottabad	Electrical	05	Dedicated
			BS	COMSATs Abbottabad	Electrical		
4	Miss Riffat Kalsoom	Lecturer	MS	NUST	Physics	04	Dedicated
			BS	COMSATs Lahore	Physics		

List of Full-Time Lab. Engineers/Teaching Assistants

Sr. No.	Name	Designation	Details of Qualifications		Specialization	Labs Conducted (Contact Hours)
			Degree	Institution		Current Semester
1	Engr. Sidra Arshad	Lab. Engr.	BS	Riphah International	Biomedical	6

Annexure – C: Lab Safety Precautions

- Be calm and relaxed, while working in Lab.
- When working with voltages over 40 V or with currents over 10 A, there must be at least two people in the Lab at all times
- Oscilloscopes are among the most expensive instruments in the lab. Be careful when working with one.
- Make sure the multi-meter is set to proper mode for the measurement being made. Never put in current mode for any other measurement.
- Apply low voltages or low power to check proper functionality of circuits
- No loose wires or metal pieces should be lying on table or near the circuit, to cause shorts and sparking.
- Avoid using long wires, that may get in your way while making adjustments or changing leads.
- Keep high voltage parts and connections out of the way from accidental touching and from any contacts to test equipment or any parts, connected to other voltage levels.
- When working with inductive circuits, reduce voltages or currents to near zero before switching open the circuits.
- BE AWARE of bracelets, rings, metal watch bands, and loose necklace (if you are wearing any of them), they conduct electricity and can cause burns. Do not wear them near an energized circuit.

Annexure – D: Assessment Team (AT) Findings

Self Assessment Team Report Submission

Self Assessment Program

Successful self assessment program includes:

a) Purpose identification
b) Outcomes identification
c) Measurements and evaluation design
d) Data collection
e) Analysis and evaluation
f) Decision making regarding actions to be taken

Self Assessment Objectives

a) Review and maintain academic standards
b) Measure and verify to check whether existing programs meet their objectives and department goals
c) Provide feedback for quality assurance of academic programs
d) Prepare the implementation plan for departmental review

Self Assessment Team

- Constituted by Quality Enhancement Cell after getting approval from Vice Chancellor, Dean, and Department Heads
- Members
    i. Engr. Muhammad Ahtasham

Conclusions of SAR

a) Training of new faculty members must be conducted
b) Teacher-student interaction may be improved
c) Faculty members should be motivated and faculty development courses must be arranged
d) Research facilities should be enhanced
e) Seminars/workshops on advanced and modern technology will be arranged

In conclusion, the strong and weak areas of the program are as under:

Strong Areas

1. Curriculum Design, development and organization are based upon set, well defined and approved criteria
2. Rigorous, intensive and rewarding program
3. Capable Faculty
4. Academic Schemes fully prepared in advance
5. The number of courses along with their titles and credit hours for each semester, course contents for degree program are fully planned
6. PEC & HEC rules fully followed

Weak Areas

1. Insufficient infrastructure
2. Low number of industry-oriented courses
3. Class rooms improvements
4. New & State of the art equipment for Labs
5. Faculty training and development courses for faculty members

Salient recommendations of self assessment team are:

Insufficient Infrastructure

a) Some class rooms have inadequate seating capacities
b) Infrastructure not available for foundry shop
c) Infrastructure not available for wood work shop
d) Infrastructure not available for forging shop

Regular Teacher Training

e) Excellent communication skills are required
f) Training of Young Faculty
g) Improve the Teaching Methodology
h) Seminars and workshops must be arranged on advanced topics
i) Preparation and delivery of lectures
j) Evaluation of students

Facilities for Students

k) Common Room for Male students
l) Ample sitting facilities in lawns and under shade
m) Sport facilities –(Basketball, Badminton, Table tennis, Cricket ground)
n) Industrial and Educational tours

Faculty Development

o) Indigenous Plans for faculty development
p) Practical skills should be enhanced
q) Research facilities and funds must be available and enhanced
r) Balance of teaching workload and research activities
s) Student teacher ratio should be adequate
t) Training of new hiring must be arranged

Syllabi Review

u) Syllabi review should be done on quarterly or yearly basis according to industry requirements

Annexure – F: Faculty Course Review Report

Department of Biomedical Engineering is running 50 courses for the BS Biomedical Engineering program. All courses curriculum is reviewed periodically by the faculty to assess its effectiveness and contribution in achieving program objectives. Course review also contributes towards making any changes in the syllabi and enhancements required in areas identified as a result of Alumni Survey and Graduating Students Feedback.

PT members launched HEC Performa 2 (Faculty of Course Review Report) to all the faculty members, to obtain their feedback about courses.

The summary of the overall feedback of all courses identified the following improvement points:

a. Syllabi review to improve communication skills.
b. Change in course curriculum to emphasis on design component.
c. Provision of more technical resources to execute final projects
d. Improvement in technical report writing skills
e. Provision to interact more with industrial units during study period.

Board of Studies scrutinized these points and presented in the Board of Faculty that will review and suggest the implementation as deemed necessary.

Annexure – G: Rubric Report

Self Assessment Report					
Criterion 1 – Program Mission, Objectives and Outcomes Weight = 0.20					
Factors	**Score**				
1. Does the program have document measurable objectives that support faculty/ college and institution mission statements?	5	**4**	3	2	1
1. Does the program have documented outcomes for graduating students?	5	4	**3**	2	1
2. Do these outcomes support the Program objectives?	5	4	3	**2**	1
3. Are the graduating students capable of performing these outcomes?	5	4	**3**	2	1
4. Does the department assess its overall performance periodically using quantifiable measures?	5	4	**3**	2	1
5. Is the result of the Program Assessment documented?	5	**4**	3	2	1
Total Encircled Value (TV)	19				
SCORE 1 (S1) = [TV/ (No. of Question * 5)] * 100 * 0.20	15.2				

Criterion 2– Curriculum Design and Organization Weight = 0.15					
Factors	**Score**				
1. Is the curriculum consistent?	5	**4**	3	2	1
2. Does the curriculum support the program's documented objectives?	5	**4**	3	2	1
3. Are the theoretical background, problem analysis and solution design stressed within the program's core material?	5	**4**	3	2	1
4. Does the curriculum satisfy the core requirements laid down by PEC?	5	**4**	3	2	1
5. Does the curriculum satisfy the major requirements laid down by HEC and the PEC?	5	**4**	3	2	1
6. Does the curriculum satisfy the professional requirements as laid down by PEC?	5	**4**	3	2	1
7. Is the information technology component integrated throughout the program?	5	**4**	3	2	1
8. Are oral and written skills of the students developed and applied in the program?	5	4	**3**	2	1
Total Encircled Value (TV)	31				
SCORE 1 (S1) = [TV/ (No. of Question * 5)] * 100 * 0.15	11.625				

Criterion 3– Laboratories and Computing Facilities Weight = 0.15					
Factors	**Score**				
1. Are the laboratory manuals/ documentation/ instructions etc. for experiments available and readily accessible to faculty and students?	5	**4**	3	2	1
2. Are there adequate number of support personnel for instruction and maintaining the laboratories?	5	**4**	3	2	1
3. Are the University's infrastructure and facilities adequate to support the program's objectives?	5	**4**	3	2	1
Total Encircled Value (TV)	12				
SCORE 1 (S1) = [TV/ (No. of Question * 5)] * 100 * 0.15	12				

Criterion 4– Student Support and Advising	Weight = 0.10				
Factors	**Score**				
1. Are the courses being offered in sufficient frequency and number for the students to complete the program in a timely manner?	5	**4**	3	2	1
2. Are the courses in the major area structured to optimize interaction between the students, faculty and teaching assistants?	5	**4**	3	2	1
3. Does the university provide academic advising on course decisions and career choices to all students?	5	**4**	3	2	1
Total Encircled Value (TV)	**12**				
SCORE 1 (S1) = [TV/ (No. of Question * 5)] * 100 * 0.10	**8**				

Criterion 5– Process Control	Weight = 0.10				
Factors	**Score**				
1. Is the process to enroll students to a program based on quantitative and qualitative criteria?	**5**	4	3	2	1
2. Is the process above clearly documented and periodically evaluated to ensure that it is meeting its objectives?	5	**4**	3	2	1
3. Is the process to register students in the program and monitoring their progress documented?	5	**4**	3	2	1
4. Is the process above periodically evaluated to ensure that it is meeting its objectives?	5	**4**	3	2	1
5. Is the process to recruit and retain faculty in place ad documented?	5	**4**	3	2	1
6. Are the process for faculty evaluation & promotion consistent with the institution mission?	5	**4**	3	2	1
7. Are the process in 5 and 6 above periodically evaluated to ensure that they are meeting their objectives?	5	**4**	3	2	1
8. Do the processes and procedures ensure that teaching and delivery of course material emphasize active learning and that course learning outcomes are met?	5	4	**3**	2	1
9. Is the process in 8 above periodically evaluated to ensure that it is meeting its objectives?	5	4	**3**	2	1
10. Is the process to ensure that graduates have completed the requirements of the program based on standards and documented procedures?	5	**4**	3	2	1
11. Is the process in 10 above periodically evaluated to ensure that it is meeting its objectives?	5	**4**	3	2	1
Total Encircled Value (TV)	**43**				
SCORE 1 (S1) = [TV/ (No. of Question * 5)] * 100 * 0.10	**7.81**				

Criterion 6– Faculty	Weight = 0.10				
Factors	**Score**				
1. Are there enough full time faculty members to provide adequate coverage of the program areas/courses with continuity and stability?	5	**4**	3	2	1
2. Are the qualifications and interest of faculty members sufficient to teach all courses, plan, modifies and updates courses and curricula?	5	**4**	3	2	1
3. Do the faculty members possess a level of competence that would be obtained through graduate work in the discipline?	5	4	**3**	2	1
4. Do the majority of faculty members hold a Ph.D. degree in their discipline?	5	4	**3**	2	1
5. Do faculty members dedicate sufficient time to research to remain current in their disciplines?	5	4	3	**2**	1
6. Are there mechanisms in place for faculty development?	5	4	3	**2**	1
7. Are faculty members motivated and satisfied so as to excel in their profession?	5	**4**	3	2	1

Total Encircled Value (TV)	**22**
SCORE 1 (S1) = [TV/ (No. of Question * 5)] * 100 * 0.10	**6.29**

Criterion 7– Institutional Facilities	**Weight = 0.10**				
Factors	**Score**				
1. Does the institution have the infrastructure to support new trends such as e-learning?	**5**	**4**	**3**	**2**	**1**
2. Does the library contain technical collection relevant to the program and is it adequate staffed?	**5**	**4**	**3**	**2**	**1**
3. Are the class rooms and offices adequately equipped and capable of helping faculty carry out their responsibilities?	**5**	**4**	**3**	**2**	**1**
Total Encircled Value (TV)	**13**				
SCORE 1 (S1) = [TV/ (No. of Question * 5)] * 100 * 0.10	**7.33**				

Criterion 8– Institutional Support	**Weight = 0.10**				
Factors	**Score**				
1. Is there sufficient support and finances to attract and retain high quality faulty?	**5**	**4**	**3**	**2**	**1**
2. Are there an adequate number of high quality graduate students, teaching assistants and Ph.D. students?	**5**	**4**	**3**	**2**	**1**
Total Encircled Value (TV)	**8**				
SCORE 1 (S1) = [TV/ (No. of Question * 5)] * 100 * 0.10	**8**				

Overall Assessment Score = S1 + S2 + S3 + S4 + S5 + S6 + S7 + S8
= 15.2 + 11 + 12 + 8 + 7.81 + 6.29 + 7.33 + 8
= 75.63