

**Quaid-e-Awam University
of Engineering, Science, & Technology
(QUEST), Nawabshah**



**OUTCOME BASED EDUCATION (OBE)
CATALOGUE**

Batch 2023 and onwards

B.E. Biomedical Engineering

Department of Biomedical Engineering

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VISION AND MISSION OF THE UNIVERSITY

The Vision and Mission of the Quaid-e-Awam University of Engineering, Science and Technology (QUEST), Nawabshah are approved on the 35th meeting of the Academic Council of the University through *Resolution No. ACAS-35.5*. The approved vision and mission of the university are given below.

Vision of the QUEST

To produce professional graduates to cater the socio-economic requirements of the national and international market for sustainable development

Mission of the QUEST

To provide quality and state-of-art Education to the students in the prescribed areas of Engineering, Science & Technology, in order to make them outstanding professionals and better human-beings; so that they become capable of contributing effectively and amicably towards sustainable development.

VISION AND MISSION OF THE DEPARTMENT

The vision and Mission of the Department of Biomedical Engineering are discussed and approved in accordance with Vision and Mission of the University as under.

Vision of the department

To provide quality education in the field of biomedical engineering to meet worldwide socio-economic requirements by improving public health

Mission of the department

To produce outstanding professional and ethically sound biomedical engineers, capable of addressing emerging issues of healthcare sectors for sustainable development

MAPPING OF VISION AND MISSION

Mapping of vision and mission the department with the vision and mission of the university is given below in the Table A.

Table A: Mapping of Vision and Mission

	Vision of the QUEST	Mission of the QUEST
Vision of the Department	✓	✓
Mission of the Department	✓	✓

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The PEOs of the B.E. Biomedical Engineering program and its mapping with the vision and mission of the university and department are discussed in detail considering the proposal of the IAB and are approved as follows.

List of the PEOs

The PEOs of the B.E. Biomedical Engineering program are:

1. PEO_1_BM_22

To demonstrate biomedical engineering knowledge to identify and address the technical problems

2. PEO_2_BM_22

To enhance intellectual and analytical abilities in taking initiative and/or developing environmentally sustainable and innovative ideas for technological growth in the field of biomedical engineering

3. PEO_3_BM_22

To work effectively as a team member or lead multidisciplinary teams while demonstrating the interpersonal and management skills and ethical responsibilities

MAPPING OF PEOs

The PEOs are consistent with the vision and mission of the department and university. The mapping of PEOs with vision and mission of the QUEST is given in Table B1.

Table B1: Mapping of PEOs with Vision and Mission of the QUEST

University's Vision and Mission	PEOs		
	PEO_1_BM_2022	PEO_2_BM_2022	PEO_3_BM_2022
Vision To produce professional graduates to cater the socio-economic requirements of the national and international market for sustainable development	✓	✓	✓
Mission To provide quality and state-of-art Education to the students in the prescribed areas of Engineering, Science & Technology, in order to make them outstanding professionals and better human-beings; so that they become capable of contributing effectively and amicably towards sustainable development.	✓	✓	✓

The mapping of PEOs with vision and mission of the Department of Biomedical Engineering is given in Table B2.

Table B2: Mapping of PEOs with Vision and Mission of the Department

Department's Vision and Mission	PEOs		
	PEO_1_BM_2022	PEO_2_BM_2022	PEO_3_BM_2022
Vision To provide quality education in the field of biomedical engineering to meet worldwide socio-economic requirements by improving public health	✓	✓	✓
Mission To produce outstanding professional and ethically sound biomedical engineers, capable of addressing emerging issues of healthcare sectors for sustainable development	✓	✓	✓

PROGRAM LEARNING OUTCOMES (PLOs)/ Graduate Attributes (GAs)

The PLOs/ GAs are recommended by PEC that was adapted from Washington Accord. The same is approved as the PLOs of the B.E. Biomedical Engineering program, as per PEC guidelines.

List of the PLOs

The 12 PLOs of the B.E. Biomedical Engineering program are as follows:

1. PLO 01: Engineering Knowledge

Ability to apply knowledge of mathematics, science and engineering fundamentals and an engineering specialization to the solution of complex engineering problems

2. PLO 02: Problem Analysis

Ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences

3. PLO 03: Design/Development of Solutions

Ability to design solutions for complex engineering problems and design systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations

4. PLO 04: Investigation

Ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions

5. PLO 05: Modern Tool Usage

Ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations

6. PLO 06: The Engineer and Society

Ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.

7. PLO 07: Environment and Sustainability

Ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development

8. PLO 08: Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice

9. PLO 09: Individual and Team Work

Ability to work effectively, as an individual or in a team, on multi-faceted and/or multidisciplinary settings

10. PLO 10: Communication

Ability to communicate effectively, orally as well as in writing on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentations, make effective presentations, and give and receive clear instructions

11. PLO 11: Project Management

Ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/ or leader in a team to manage projects in a multidisciplinary environment

12. PLO 12: Lifelong Learning

Ability to recognize importance of and pursue lifelong learning in the broader context of innovation and technological developments.

MAPPING OF PLOs

The mapping of PLOs with the PEOs of the B.E. Biomedical Engineering program is given in Table C1.

Table C1: Mapping of PLOs with the PEOs

Program Learning Outcomes (PLOs)		PEOs		
		PEO_1_BM_2022	PEO_2_BM_2022	PEO_3_BM_2022
PLO 01	Engineering Knowledge	✓		
PLO 02	Problem Analysis	✓		
PLO 03	Design/Development of Solutions		✓	
PLO 04	Investigation	✓		
PLO 05	Modern Tool Usage	✓		
PLO 06	The Engineer and Society		✓	
PLO 07	Environment and Sustainability		✓	
PLO 08	Ethics			✓
PLO 09	Individual and Team Work			✓
PLO 10	Communication			✓
PLO 11	Project Management			✓
PLO 12	Lifelong Learning		✓	

Scheme of Studies (B.E. Biomedical Engineering) for 23BME and onwards batches

1st Semester 1st Year					
S. No.	Code	Course Title	Theory	Lab	Combined
1	MTH121	Applied Physics	3	1	4
2	CS100	Computer Fundamental	2	1	3
3	MTH106	Functional English	3	0	3
4	MTH122	Basic Mathematics	3	0	3
	MTH123	Basic Biology			
5	BM101	Introduction to Biomedical Engineering	2	0	2
6	MTH105	Islamic Studies	2	0	2
Total Semester Credit Hours			15	2	17
2nd Semester 1st Year					
S. No.	Code	Course Title	Theory	Lab	Combined
1	ES104	Basic Electronic Engineering	3	1	4
2	MTH101	Applied Calculus	3	0	3
3	BM103	Physiology	3	1	4
4	ES105	Circuit Analysis	3	1	4
5	MTH107	Communication Skills	3	0	3
Total Semester Credit Hours			15	3	18
1st Semester 2nd Year					
S. No.	Code	Course Title	Theory	Lab	Combined
1	MTH-203	Complex Variable & Transform	3	0	3
2	ES210	Computer Aided Engineering Design	0	1	1
3	ES208	Digital Logic Design	3	1	4
4	BM202	Human Anatomy	2	1	3
5	CS-113	Object Oriented Programming	2	1	3
Total Semester Credit Hours			10	4	14
2nd Semester 2nd Year					
S. No.	Code	Course Title	Theory	Lab	Combined
1	BM203	Biomedical Electronics	3	1	4
2	BM204	Biochemistry	2	1	3
3	MTH204	Numerical Analysis & Computer Applications	3	1	4
4	MTH104	Pakistan Studies	2	0	2
5	ES221	Signals & Systems	3	1	4
Total Semester Credit Hours			13	4	17

1st Semester 3rd Year					
S. No.	Code	Course Title	Theory	Lab	Combined
1	BM301	Biomedical Instrumentation I	3	1	4
2	MTH301	Statistics & Probability	3	0	3
3	ES215	Embedded System Design	3	1	4
4	BM308	Biomechanics	3	1	4
5	BM303	Biomedical Signal Processing	3	1	4
Total Semester Credit Hours			15	4	19
2nd Semester 3rd Year					
S. No.	Code	Course Title	Theory	Lab	Combined
1	BM304	Biomedical Instrumentation II	3	1	4
2	BMXXX	Elective-I	3	0	3
3	BM306	Biomedical Control Systems	3	1	4
4	CS321	Modelling & Simulation	2	1	3
5	MTH421	Engineering Management	2	0	2
Total Semester Credit Hours			13	3	16
1st Semester Final Year					
S. No.	Code	Course Title	Theory	Lab	Combined
1	MTH423	Professional Practices & Ethics	2	0	2
2	BM401	Medical Imaging	2	1	3
3	ES410	Power Electronics	3	1	4
4	BMXXX	Elective-II	3	0	3
5	BM411	Final Year Design Project-I	0	3	3
Total Semester Credit Hours			10	5	15
2nd Semester Final Year					
S. No.	Code	Course Title	Theory	Lab	Combined
1	BMXXX	Elective-III	3	0	3
2	BM307	Biomaterials	3	1	4
3	BMXXX	Elective-IV	3	0	3
4	MTH424	Entrepreneurship	2	0	2
5	BM412	Final Year Design Project-II	0	3	3
Total Semester Credit Hours			11	4	15
Total Credit Hours			102	29	131

Elective Courses

S. No.	Course Code	Name of Elective Courses
1.	BM431	Medical Device Quality System and Standards
2.	BM432	Biomedical Engineering Systems
3.	BM433	Medical Device Regulatory Affairs
4.	BM434	Medical Robotics
5.	BM435	Rehabilitation Engineering
6.	BM436	Nano Biotechnology
7.	BM437	Telemedicine Systems
8.	BM438	Artificial Intelligence
9.	BM440	Hospital Information System

Mapping of Curriculum to PLOs

B.E. Biomedical Engineering Courses		Program Learning Outcomes											
Course Code	Course Title	PLO 01	PLO 02	PLO 03	PLO 04	PLO 05	PLO 06	PLO 07	PLO 08	PLO 09	PLO 10	PLO 11	PLO 12
1st Semester 1st Year													
MTH121	Applied Physics	C2, P3	C3										
CS100	Computer Fundamental	C2, P3											
MTH106	Functional English										C3		
MTH122	Basic Mathematics	C1, C3											
MTH123	Basic Biology	C2											
BM101	Introduction to Biomedical Engineering	C2											
MTH105	Islamic Studies								C3				C3
2nd Semester 1st Year													
ES104	Basic Electronic Engineering	C2	C4		P3								
MTH101	Applied Calculus		C3										
BM103	Physiology	C2, P2											
ES105	Circuit Analysis		C2, P4										
MTH107	Communication Skills										C3		
1st Semester 2nd Year													
MTH-203	Complex Variable & Transform		C3										
ES210	Computer Aided Engineering Design	P2				P3				A3			
ES208	Digital Logic Design	C2	C3		C4	P3				A3			
BM202	Human Anatomy	C2, C4, P3											
CS-113	Object Oriented Programming		C2	C3	C3	P3							
2nd Semester 2nd Year													
BM203	Biomedical Electronics	C2	C4		P3								
BM204	Biochemistry	C2	C2		P3								
MTH204	Numerical Analysis & Computer Applications		C3										
MTH104	Pakistan Studies						C2						C2
ES221	Signals & Systems	C2	C2, C3			P3							
1st Semester 3rd Year													
BM301	Biomedical Instrumentation I	C2		P3						A4		C5	
MTH301	Statistics & Probability		C3										
ES215	Embedded System Design	C2	C3			P3							
BM308	Biomechanics		P2								C2, C4		
BM303	Biomedical Signal Processing	C2		C6	C4, P3								

Course Code	Course Title	PLO 01	PLO 02	PLO 03	PLO 04	PLO 05	PLO 06	PLO 07	PLO 08	PLO 09	PLO 10	PLO 11	PLO 12
2nd Semester 3rd Year													
BM304	Biomedical Instrumentation II	C2		C2			P2	A4					
BMXXX	Elective-I	C2, C3											
BM306	Biomedical Control Systems	C2			C4	P3							
CS321	Modelling & Simulation	C2			C4			A4				P2	
MTH421	Engineering Management			C6	C5					C2		C2	
1st Semester Final Year													
MTH423	Professional Practices & Ethics								C2, C3, A3				
BM401	Medical Imaging	C2	C3		P3		A4						
ES410	Power Electronics	C2	C4		P3								
BMXXX	Elective-II	C2, C3											
BM411	Final Year Design Project-I	C5	C4	P3	P3	P3	A4	A4	A4	A4	A4	C6	
2nd Semester Final Year													
BMXXX	Elective-III	C2, C3											
BM307	Biomaterials	C2		C2		P1		C3					
BMXXX	Elective-IV	C2, C3											
MTH424	Entrepreneurship								A3			A3	C2
BM412	Final Year Design Project-II		C5	C6	P3		A4	A4	A4	A4	A4	P3	A4
PLO Frequency		27	18	8	13	8	5	5	5	6	5	6	4

**FRAME WORK FOR B.E. BIOMEDICAL ENGINEERING
(AS PER REVISED PEC FRAME WORK 2023)**

Knowledge Profile (WK-1 to WK-9)	Knowledge Area	Sub- Area	PEC-HEC Recommended	Institute's Program Breakup
			Credit Hours	Credit Hours
General Education/ Non-Engineering Domain				
WK-1/ WK-2	Natural Sciences	Math	12-15	13
		Physics	3-9	10
		Chemistry		
		Natural Science/ Math Elective		
WK-1/ WK-5/ WK-7/ WK-9	Humanities	English	3	3
			3	3
		Culture	2	2
			2	2
			2	
	Social Science	2	2	
		2		
	Management Sciences	Professional Practice	2	2
			2	2
Computer Sciences	Basic Computing	3	3	
Total (subsection)			Min 38	42
Engineering Domain				
WK-2/ WK-4/ WK-5	Advanced Computer and Information Sciences	ICT/ AI/ Data Science/ Cyber Security	6-9	6
WK-2/ WK-3	Foundation Engineering Courses		22-24	22
WK-1/ WK-2/ WK-4	Core Breadth of Engineering Disciplines		22-24	23
WK-5/ WK-6	Core Depth of Engineering Disciplines		22-24	22
			Min 72	73
WK-1/ WK-2/ WK-3/ WK-4/ WK-7/ WK-9	Multi-disciplinary Engineering Courses		6	7
Total (subsection)			Min 06	07
WK-4/ WK-5/ WK-6/ WK-7/ WK-8/ WK-9	Final Year Design Project (FYDP)/ Capstone	Integration of innovative, creative, technical, management and presentation skills of a graduate towards final year	6	6
Total (subsection)			06	06
WK-6/ WK-7/ WK-9	Industrial Training	Internship (06-08 Weeks)	Mandatory & Qualifying	
	Flexible Engineering/ Non- Engineering) Courses may be adjusted as per the requirements		8-14	3
Total (Credit Hours)			130-136	131

COURSE-WISE FRAME WORK FOR B.E. BIOMEDICAL ENGINEERING

Knowledge Profile (WK-1 to WK-9)	Knowledge Area	Subject Area	Name of Courses	Th	Lab	Cr. Hrs	Total Courses	Total Credits
General Education Domain/ Non-Engineering Domain								
WK-1/ WK-2	Natural Sciences	Mathematics	Applied Calculus	3	0	3	4	13
			Complex Variable & Transform	3	0	3		
			Numerical Analysis & Computer Applications	3	1	4		
			Statistics & Probability	3	0	3		
		Natural Sciences	Applied Physics	3	1	4	3	10
			Basic Biology/ Basic Mathematics	3	0	3		
			Biochemistry	2	1	3		
WK-1/ WK-5/ WK-7/ WK-9	Humanities	English	Functional English	3	0	3	2	6
			Communication Skills	3	0	3		
		Culture	Islamic Studies or Ethics	2	0	2	2	4
			Pakistan Studies	2	0	2		
		Social Science	Professional Practices & Ethics	2	0	2	1	2
		Management Sciences	Professional Practice	Engineering Management	2	0	2	2
	Entrepreneurship			2	0	2		
	Computer Sciences	Basic Computing	Computer Fundamental	2	1	3	1	3
	Total (General Education Domain/ Non-Engineering Domain)							15
Engineering Domain								
WK-2/ WK-4/ WK-5	Advanced Computer and Information Sciences	ICT/ AI/ Data Science/ Cyber Security	Object Oriented Programming	2	1	3	2	6
			Artificial Intelligence	3	0	3		
WK-2/ WK-3	Engineering Foundation		Introduction to Biomedical Engineering	2	0	2	7	22
			Basic Electronic Engineering	3	1	4		
			Physiology	3	1	4		
			Circuit Analysis	3	1	4		
			Computer Aided Engineering Design	0	1	1		
			Digital Logic Design	3	1	4		
			Human Anatomy	2	1	3		

Department of Biomedical Engineering QUEST, Nawabshah

WK-1/ WK-2/ WK-4	Major Based Core (Breadth)		Biomedical Electronics	3	1	4	6	23
			Signals & Systems	3	1	4		
			Biomedical Instrumentation I	3	1	4		
			Embedded System Design	3	1	4		
			Biomedical Signal Processing	3	1	4		
			Elective-I	3	0	3		
WK-5/ WK-6	Major Based Core (Depth)		Biomechanics	3	1	4	7	25
			Biomedical Instrumentation II	3	1	4		
			Biomedical Control Systems	3	1	4		
			Modelling & Simulation	2	1	3		
			Medical Imaging	2	1	3		
			Elective-III	3	0	3		
			Biomaterials	3	1	4		
WK-1/ WK-2/ WK-3/ WK-4/ WK-7/ WK-9	Multi- disciplinary Engineering Courses		Power Electronics	3	1	4	2	7
			Elective-II	3	0	3		
WK-4/ WK-5/ WK-6/ WK-7/ WK-8/ WK-9	Final Year Design Project (FYDP)/ Capstone		FYDP-I	0	3	3		6
			FYDP-II	0	3	3		
WK-6/ WK-7/ WK-9	Industrial Training	Internship (06-08 Weeks)			Mandatory & Qualifying			
Total (Engineering Domain)							24	89
Total (Credit Hours)								131

Key Performance Indicators (KPIs)

Table: KPIs evaluation and attainment criteria for PEO, PLO, and CLO

	Level	Evaluation Tool	KPI	Data Collection Frequency	Data Analysis Frequency
PEO	Program	-For Indirect Cohort: Employer and Alumni Surveys	50% of the responses must attain a score of 3 or above on a scale of 1 to 5.	Every year	4 years from graduation
PLO	Student	CLO scores of the student in the mapped course(s)	Each PLO must be attained in at least 50% of the respective mapped course(s), with an average score of at least 50%	Every semester	Every semester
	Course	PLO scores of all the students in the mapped course	At least 50% of the students must attain that PLO		
	Program	- For Direct Cohort: Final PLO attainment statistics of all the courses including FYDP -For Indirect Cohort: Internship Feedback Form and Exit Survey	For Direct Cohort, at least 50% of the mapped courses must attain the PLO. For Indirect Cohort, at least 50% of the students/ responses must attain a score of 3 or above on a scale of 1 to 5.	At the time of graduation	At the time of graduation
CLO	Student	Course work	The student must obtain at least 50% average percentage score from all attempts.	Every semester	Every semester
	Course	CLO scores of all students in the course	At least 50% of the students must attain that CLO		

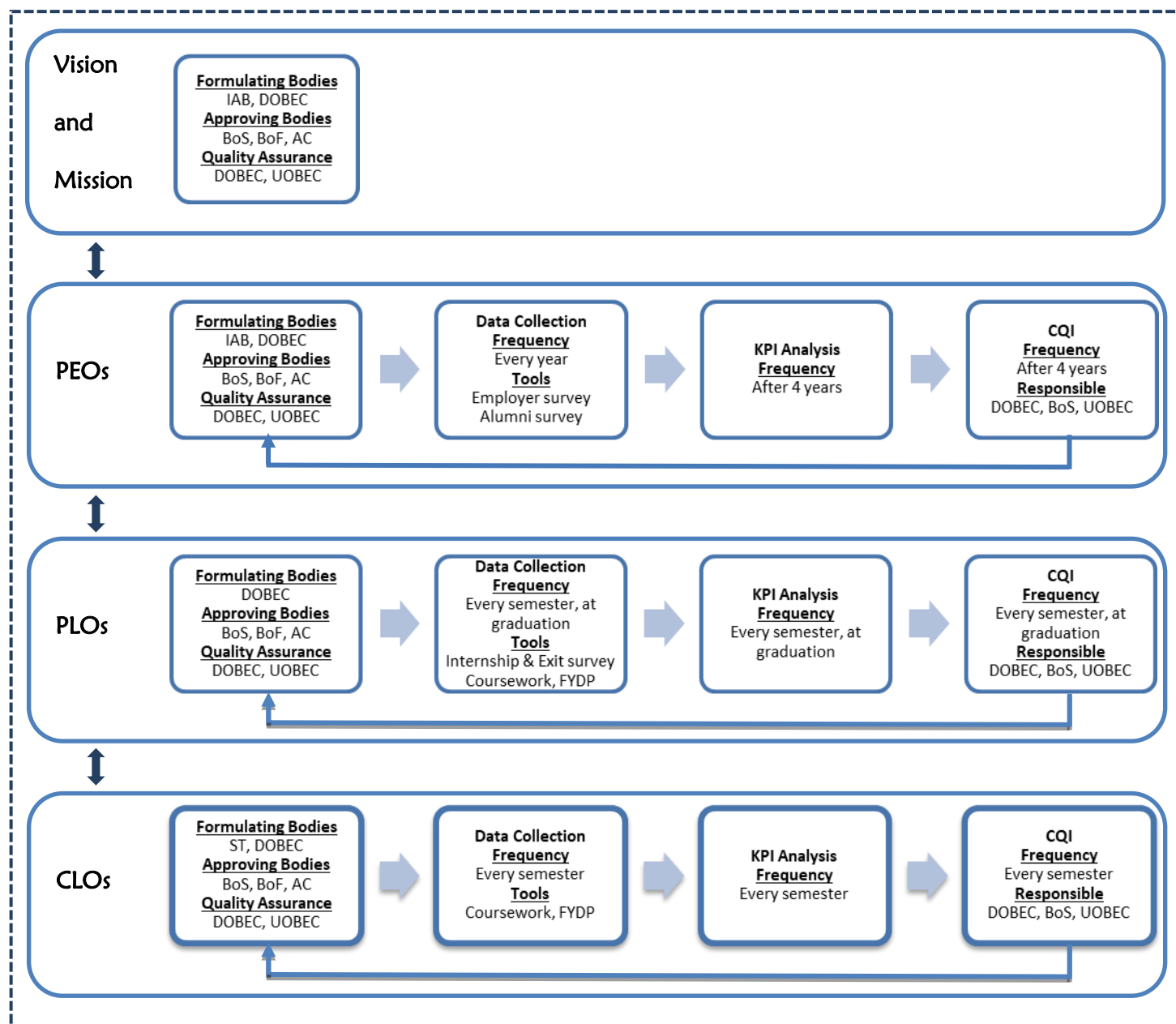
Continuous Quality Improvement (CQI)

Table: CQI actions for PEO, PLO, and CLO

	KPI Achieved	KPI Not Achieved		
		Program Level	Course Level	Student Level
PEO	No action required	1. Review of curriculum strategies	N/A	N/A
		2. Review of assessment methods		
		3. Review of the relevant KPIs		
		4. Review of PEOs		
PLO	No action required	1. Review of teaching and learning process.	1. Review of teaching and learning process.	1. Warning through the progressive attainment sheet.
		2. Review of PLOs assessment methods.	2. Review of CLOs assessment methods.	2. Student counseling.
		3. Review of Course-PLO mapping and the relevant KPIs.	3. Review of CLO- PLO mapping and the relevant KPIs.	
		4. Review of curriculum design.	4. Review of curriculum design.	
CLO	No action required	N/A	1. Review of CLO assessment methods.	1. Student provided further chances through direct assessment tools.
			2. Review of CLOs and taxonomy levels.	2. Student counseling.
			3. Review of students' course feedback.	
			4. Review of CLO KPI	
			5. Faculty advice by DOBEC.	
			6. Faculty training	

OBE Implementation Framework

The detailed process of OBE implementation framework as outlined in the Manual of Uniform OBE Implementation.



Course Profiles for Batch 2023 and onwards

DETAILS OF COURSES
FOR BACHELOR IN BIOMEDICAL ENGINEERING
MTH101-Applied Physics

Contact Hours:

Theory = 45

Practical = 45

Total = 90

Credit Hours:

Theory = 3.0

Practical = 1.0

Total = 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain basic laws/ principles of Applied physics	Cognitive	2	1
2.	Solve numerical problems of applied physics by using basic mathematical knowledge	Cognitive	3	2
3.	Practice of operating equipment/tools to understand laws/principles of physics under supervision	Psychomotor	3	1

Course Outline:

1. Properties of Matter

- a. Elasticity and modulus of Elasticity
- b. Experimental determination of young's modulus
- c. Bending of beams
- d. Cantilever.

2. Fluids

- a. Steady and turbulent flow
- b. Bernoulli's theorem, Viscosity
- c. determination of Coefficient of viscosity by Poiseuille's method
- d. Surface tension
- e. Surface energy
- f. Angle of contact
- g. Determination surface tension by rise in a capillary tube.

3. Heat and Thermodynamics

- a. Heat, Temperature, and Theories of heat
- b. Adiabatic and isothermal processes
- c. The four laws of thermodynamics
- d. Thermodynamic functions

- e. Efficiency of Heat Engines
 - f. Carnot's Cycle
 - g. Entropy
 - h. Reversible Process and cycles
 - i. Thermodynamic equilibrium
 - j. Introduction to Heat transfer Mechanisms.
- 4. Optics**
- a. Waves and Oscillations
 - b. Simple Harmonic Motion
 - c. types of wave motion
 - d. Optics of light
 - e. Interference
 - f. Diffraction
 - g. Polarization
 - h. Double refraction
 - i. Dispersion
 - j. Types and uses of Deviation Lasers
- 5. Electricity and Magnetism**
- a. Electric charges
 - b. Electric field
 - c. Electric potential
 - d. Coulomb 's law
 - e. Gauss 's law
 - f. Capacitors and dielectrics
 - g. Electric current
 - h. Ohm's Law
 - i. Magnetic properties of matter
 - j. Magnetic field
 - k. Magnetic force concurrent
 - l. Ampere's law, Faraday's law, and Lenz 's law
- 6. Sound**
- a. Hearing and Echolocation
 - b. Ultrasound

Practical Outline:

Perform experiments to understand and observe laws and or principles of Heat and thermodynamics, Optics, Electricity and Magnetism, and Sound.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester (20%)

Final Semester (60%)

- **Laboratory (100%)**

Sessional (40%)

Lab Rubrics (30%)

Mini Project/ Open ended Lab (10%)

Semester Lab Exam (60%)

Objective type test (20%)

Conduct of Practical/ Viva voce (40%)

Text and Reference 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

CS100-Computer Fundamental

Contact Hours:

Theory =30

Practical=45

Total=75

Credit Hours:

Theory = 2.0

Practical = 1.0

Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Discuss the fundamental computer organization and working principles of computer hardware and software, and concepts of operating system, file management, application software, and computer networking.	Cognitive	2	1
2.	Explain the fundamental programming concepts in Python.	Cognitive	2	1
3.	Demonstrate the fundamental programming concepts in Python.	Psychomotor	3	1

Course Outline:

Computer defined Application areas of computer, Generations of computers, Information/Data Processing Cycle, Classification on the basis of: Mechanism, Size, and Purpose, Keyboard, pointing devices (Mouse, Trackball, Trackpad, Joystick, Game controllers), Scanner, Barcode Reader, Finger Print Reader, Microphone, Digital Camera, Monitors: Cathode Ray Tube (CRT) and Flat Panel Displays (FPD), Printers, Projectors, Speakers and Plotters. Random Access memory (RAM), Read Only Memory (ROM), Flash Memory, Types of RAM: DRAM and SRAM, Types of ROM: PROM, EPROM and EEPROM, Hierarchy of memory devices: Ternary, Secondary, Primary, Cache, Registers, Introduction to storage devices, Magnetic storage, Program, Software, Types of software: System and Application, System software: System Management Programs, System Support Programs, System Development Programs, Applications software: General-Purpose Application Programs, Application-Specific Programs, Operating System, Utilities, Device Drivers, Language Translators. Network, Internet, Intranet, Extranet, Network Types: LAN, MAN, WAN, PAN, WLAN, Peer-to-Peer (P2P), Home network, Network Topologies: Bus, Ring, Star, Mesh, Tree, Hybrid, Client, Server, IP Address.

Basics of programming, introduction to Python, writing / compiling programs, debugging, variables declaration / definition, programming constructs, libraries, loops, control statements, arithmetic and logical operators.

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

- **Laboratory (100%)**

Text and Reference Books:

1. Faithe Wempen, Computing Fundamentals: Introduction to Computers, John Wiley & Sons, Inc., 2014.
2. Yashavant P. Kanetkar, Let us C, Computer science series Infinity Science Series, Infinity Science Press, 2008.
3. Peter Norton's Introduction to Computers 6th Edition. Mark Lutz, Learning Python, 5th Edition, 2013.

MTH106-Functional English

Contact Hours:

Theory = 45

Practical= 00

Total= 45

Credit Hours:

Theory = 3.0

Practical = 0.0

Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Illustrate varied contents including official letters, e-mails, and applications and summarize the texts using appropriate grammatical mechanisms and cohesive devices, demonstrate their skills using English language to express their point of view, show arguments and deliver a presentation in a real-life situation.	Cognitive	3	10
2.	Apply skimming, scanning and detailed reading and listening strategies to understand gist of the text/conversation	Cognitive	3	10

Course Outline:

Basics of Grammar

- Parts of speech and use of articles
- Sentence structure, active and passive voice
- Practice in unified sentence
- Analysis of phrase, clause and sentence structure
- Transitive and intransitive verbs
- Punctuation and spelling

Comprehension

Answers to questions on a given text

Discussion

General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

Listening

To be improved by showing documentaries/films carefully selected by subject teachers

Translation skills

Urdu to English

Paragraph writing

Topics to be chosen at the discretion of the teacher

Presentation skills

Introduction

Note: Extensive reading is required for vocabulary building

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester (20%)

Final Semester (60%)

Recommended books:

1. Functional English

a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492

2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

c) Reading/Comprehension

1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. .

d) Speaking

MTH122-Basic Mathematics

Contact Hours:

Theory = 45
Practical = 00
Total = 45

Credit Hours:

Theory = 3.0
Practical = 0.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Define the several areas of mathematics	Cognitive	1	1
2.	Solve different mathematical problems using algebra, quadratic equations, cube root of unity, matrices, determinants, binomial expansion, partial fractions, trigonometric functions, differentiation, integration and/ or coordination geometry	Cognitive	3	1

Course Outline:

- 1. Algebra**
 - a. Complex Numbers
 - b. Properties of complex numbers
 - c. Conjugates and modulus
 - d. Geometrical representation of complex numbers $a+ib$.
- 2. Quadratic Equations**
 - a. Roots of a quadratic equation (real, distinct, equal and imaginary roots)
 - b. Formation of quadratic equation when the roots are given
- 3. Cube Root of Unity**
 - a. Properties of cube root of unity; ω , ω^2 , $1 + \omega + \omega^2 = 0$, etc.
- 4. Matrices**
 - a. Properties, sum, difference and multiplication of matrices
 - b. Cramer's rule
 - c. Solution of linear equations of three unknowns
- 5. Determinants**
 - a. Properties: addition, subtraction and multiplication of determinants
 - b. Sequence and series
 - c. Arithmetic progression
 - d. Standard forms of an A.P.
 - e. Arithmetic means
 - f. Geometric progression
 - g. Standard forms of a G.P.,

- h. Sum of Infinite geometric series
 - i. Geometric means
 - j. Harmonic progression
 - k. Harmonic means
 - l. Relation between H.M., A.M. and G.M.
- 6. Binomial Expansion**
- a. Expansion of type $(a+b)^n$ for positive integer of 'n'
 - b. Use of the general Binomial theorem and determine the middle term or terms of the expansion.
- 7. Partial Fractions**
- a. Resolve into partial fractions
 - b. Proper and improper fraction
- 8. Functions:**
- a. One-one function
 - b. Onto function
 - c. Even function
 - d. Odd function
 - e. Exponential function
 - f. Trigonometric function
 - g. Logarithmic function
- 9. Circular Measure**
- a. Understand the definition of radians and use the relationship between radians and degrees.
- 10. Trigonometric Functions**
- a. Basic functions e.g. sine, cosine, tangent etc. relation between them
 - b. Trigonometric identities, sum and difference formulae, multiple angle formulae
 - c. Express type $\{a(\sin\theta) + b(\cos\theta)\}$ into $R\sin(\theta \pm \phi)$ etc.
 - d. Inverse functions
- 11. Differential Calculus**
- a. Limits: Basic concepts
 - b. Limit of form $\{(\sin \theta)/ \theta\} = 1$; when θ tends to zero.
 - c. Exponent functions and type a^x etc.
- 12. Differentiation**
- a. Differentiation of x^n product and quotient formula
 - b. Trigonometric, exponents and logarithmic functions
 - c. Differentiation of implicit function, parametric function
 - d. Higher order Derivatives
 - e. Applications of differentiations
 - f. Minima and maxima
 - g. Tangent and normal velocity and acceleration

- h. Rate of reaction

13. Integral Calculus

- a. Basic Integration
- b. Integrals of sum of powers of ' χ '
- c. Trigonometric, exponent and logarithmic functions
- d. Integration by parts: e.g $\chi \sin \chi$, χe^{χ} and $\log \chi$ etc.
- e. Substitution method

14. Coordinate Geometry

- a. Lines
- b. Find length, mid-point, gradient of line segment, given the coordinates of endpoints
- c. Different forms of equation of a line
- d. Angle between two lines, distance of a point from a line

Suggested Assessment:

• **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester (20%)

Final Semester (60%)

Text and Reference Books:

1. FSC Maths Part I/II

MTH123-Basic Biology

Contact Hours:

Theory = 45

Practical= 00

Total= 45

Credit Hours:

Theory = 3.0

Practical = 0.0

Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain cell structure and function, biological molecules, and function of DNA and RNA with respect to human body	Cognitive	2	1
2.	Describe the role of enzyme, bioenergetics, biodiversity, continuity in life and also discuss application of biology	Cognitive	2	1

Course Outline:

1. Cell Structure and Function

- Techniques used in Cell Biology
- Cell Wall and Plasma Membrane – The Boundary Wall
- Cytoplasm and Organelles
- Prokaryotic and Eukaryotic Cells

2. Biological Molecules

- Biological Molecules in Protoplasm
- Importance of Water (Importance in Protoplasm and in Environment)
- Carbohydrates
- Proteins
- Lipids
- Nucleic Acids
- Conjugated Molecules (Glycolipids, Glycoprotein's, Lipoproteins and Nucleoproteins)

3. Enzymes

- Structure of Enzymes
- Mechanism of Enzyme Action
- Factors affecting the Rate of Enzymatic Action (Temperature, pH, Enzyme Concentration and Substrate Concentration)
- Enzyme Inhibition (Competitive and Noncompetitive Inhibitors)

- e. Classification of Enzymes
- 4. Bioenergetics**
 - a. Aerobic and Anaerobic respiration
 - b. Mechanism of Respiration
 - c. Synthesis of ATP – Chemiosmosis and Substrate-level Phosphorylation
- 5. Biodiversity**
 - a. A cellular life
 - b. Prokaryotes
 - c. Diversity among animals
 - d. Digestion
 - e. Circulation
 - f. Immunity
 - g. Respiration
 - h. Homeostasis
 - i. Support and movement
 - j. Nervous coordination
 - k. Chemical coordination
- 6. Continuity in Life**
 - a. Reproduction
 - b. Development and aging
 - c. Inheritance
 - d. Chromosome and DNA
 - e. Evolution
- 7. Application of Biology**
 - a. Gene Cloning (Recombinant DNA Technology and Polymerase Chain Reaction)
 - b. DNA Sequencing
 - c. DNA Analysis
 - d. Genome Maps
 - e. Tissue culture
 - f. Transgenic bacteria, plants and animals
 - g. Biotechnology and healthcare
 - h. Scope and importance of biotechnology
 - i. Vaccination and integrated disease management
 - j. Animal husbandry
 - k. Latest techniques applied to enhance crop and fruit yields
 - l. Home gardening
 - m. Role of microbes in human welfare

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester (20%)

Final Semester (60%)

Recommended and Text 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. AQA A-Level Biology, Pauline Lowrie, MarkSmith

BM101-Introduction to Biomedical Engineering

Contact Hours:

Theory = 30
Practical= 00
Total= 30

Credit Hours:

Theory = 2.0
Practical = 0.0
Total = 2.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain the basic knowledge of Biomedical engineering	Cognitive	2	1
2.	Describe the applications of Biomedical Engineering with examples	Cognitive	2	1

Course Outline:

- 1. Biomedical Engineering**
 - a. What is biomedical engineering
 - b. Branches of biomedical engineering
 - c. Role of biomedical engineer
- 2. Devices used in Biomedical Engineering**
 - a. Biomedical instrumentation fundamental
 - b. Critical care devices used in biomedical engineering
 - c. Radiological instrumentation.
 - d. Diagnostic biomedical devices
 - e. Therapeutic Biomedical devices
- 3. Applications of Biomedical Engineering**
 - a. Rehabilitation Engineering
 - b. Physiological modeling and simulation
 - c. Biomedical signal processing
 - d. Clinical Engineering
 - e. Biomaterials
 - f. Biomechanics
 - g. Tissue Engineering and regenerative medicine
 - h. Neural engineering
 - i. Medical Image Processing

Suggested Teaching Methodology:

- Lecturing
- Written Assignments

- Guest Speaker
- Report Writing

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester (20%)

Final Semester (60%)

Text and Reference books:

1. Introduction to Biomedical Engineering, Latest Edition, John Enderle
2. Biomedical Engineering Handbook Volume I & II, J. D. Bronzino

MTH105-Islamic Studies/Ethics

Contact Hours:

Theory = 30
Practical= 00
Total= 30

Credit Hours:

Theory = 2.0
Practical = 0.0
Total = 2.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Illustrate basic information and understanding of Islamic principles	Cognitive	3	12
2.	Discuss issues related to faith and religious life	Cognitive	3	8

Course Outline:

- 1. Introduction to Quranic Studies**
 - a. Basic Concepts of Quran
 - b. History of Quran
 - c. Uloom-ul-Quran
- 2. Study of Selected Text of Holly Quran**
 - a. Verses of Surah Al-Baqra Related to Faith (VerseNo-284-286)
 - b. Verses of Surah Al-Hujrat Related to Adab Al-Nabi (VerseNo-1-18)
 - c. Verses of Surah Al-Mumanoon Related to Characteristics of faithful (VerseNo-1-11)
 - d. Verses of Surah al-Furqan Related to Social Ethics (VerseNo.63-77)
 - e. Verses of Surah Al-Inam Related to Ihkam (VerseNo-152-154)
- 3. Study of Selected Text of Holy Quran**
 - a. Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
 - b. Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
 - c. Verses of Surah Al-Saf Related to Tafakar, Tadabar (VerseNo-1,14)
- 4. Seerat of Holy Prophet (S.A.W)**
 - a. Life of Muhammad Bin Abdullah (Before Prophet Hood)
 - b. Life of Holy Prophet (S.A.W) in Makkah
 - c. Important Lessons Derived from the life of Holy Prophet in Makkah
- 5. Seerat of Holy Prophet (S.A.W)**
 - a. Life of Holy Prophet (S.A.W) in Madina
 - b. Important Events of Life Holy Prophet in Madina
 - c. Important Lessons Derived from the life of Holy Prophet inMadina
- 6. Introduction to Sunnah**
 - a. Basic Concepts of Hadith
 - b. History of Hadith

- c. Kinds of Hadith
- d. Uloom-ul-Hadith
- e. Sunnah & Hadith
- f. Legal Position of Sunnah
- 7. **Selected Study from Text of Hadith:**
- 8. **Islamic Law & Jurisprudence**
 - a. Basic Concepts of Islamic Law & Jurisprudence
 - b. History & Importance of Islamic Law & Jurisprudence
 - c. Sources of Islamic Law & Jurisprudence
 - d. Nature of Differences in Islamic Law
 - e. Islam and Sectarianism
- 9. **Islamic Culture & Civilization**
 - a. Basic Concepts of Islamic Culture & Civilization
 - b. Historical Development of Islamic Culture & Civilization
 - c. Characteristics of Islamic Culture & Civilization
 - d. Islamic Culture & Civilization and Contemporary Issues
- 10. **Islam & Science**
 - a. Basic Concepts of Islam & Science
 - b. Contributions of Muslims in the Development of Science
 - c. Quran & Science
- 11. **Islamic Economic System**
 - a. Basic Concepts of Islamic Economic System
 - b. Means of Distribution of wealth in Islamic Economics
 - c. Islamic Concept forbid
 - d. Islamic Ways of Trade & Commerce
- 12. **Political System of Islam**
 - a. Basic Concepts of Islamic Political System
 - b. Islamic Concept of Sovereignty
 - c. Basic Institutions of Govt. in Islam
- 13. **Islamic History**
 - a. Period of Khlaft-e-Rashida
 - b. Period of Ummayyads
 - c. Period of Abbasids
- 14. **Social System of Islam**
 - a. Basic concepts of Social System of Islam
 - b. Elements of Family
 - c. Ethical values of Islam

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester (20%)

Final Semester (60%)

Text and Reference Books:

1. Hameedullah Muhammad, "Emergence of Islam" , IRI, Islamabad
2. Hameedullah Muhammad, "Muslim Conduct of State"
3. Hameedullah 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 ShariaAl Islamia" Allama Iqbal Open University, Islamabad(2001).

ES104-Basic Electronic Engineering

Contact Hours:

Theory = 45
Practical= 45
Total= 90

Credit Hours:

Theory = 3.0
Practical = 1.0
Total = 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Discuss the basic concepts of semiconductor devices and the formation of PN junctions, diodes and transistors.	Cognitive	2	1
2.	Examine the semiconductor devices as rectifiers, clipper and clamper circuits, voltage multipliers, and amplifiers.	Cognitive	4	2
3.	Under supervision , construct basic circuits with diodes, bipolar junction transistors and field-effect transistors for different applications such as rectifiers, amplifiers and power supplies and also with simulation tools to investigate the behavior of the circuits.	Psychomotor	3	4

Course outline:

- Introduction to electronics: diodes:
PN junction diode, forward and reverse characteristics of a diode, ideal diode, practical diode, equivalent circuit of a diode, current equation of a diode, diode as a switch.
- Types of diodes
Schottky diode, zener diode, tunnel diode, varactor diode, LED, laser diode.
- Applications of diode
Half-and full-wave rectifiers, clipper and clamper circuits, voltage multipliers.
- Bipolar junction transistor
Operation, npn and pnp transistors, unbiased transistors, DC biasing of a transistor, static characteristics, DC circuit analysis, load line, operating point and bias stabilization, Transistor as an amplifier.
- Transistor biasing configurations
Common emitter, common base, common collector. Field-effect transistor.

- FET biasing techniques

Common drain, common source and common gate, fixed bias and self bias configurations, voltage divider biasing, universal JFET bias curve, darlington pair.

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester (20%)

Final Semester (60%)

- **Laboratory (100%)**

Sessional (40%)

Lab Rubrics (30%)

Mini Project/ Open ended Lab (10%)

Semester Lab Exam (60%)

Objective type test (20%)

Conduct of Practical/ Viva voce (40%)

Recommended Books

1. Robert Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", Prentice Hall, latest edition.
2. Robert Paynter, "Introductory Electronic Devices and Circuits: Electron Flow Version", Latest Edition, Prentice Hall, ISBN: 0131716395.

MTH101-Applied Calculus

Contact Hours:

Theory =45
Practical=00
Total=45

Credit Hours:

Theory = 3.0
Practical = 0.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Apply the knowledge of Functions and their graphs, Derivatives and Antiderivatives, and Vector algebra and Calculus.	Cognitive	3	2
2.	Solve First order and higher order linear differential equations.	Cognitive	3	2

Course Outline:

Introduction to functions and their graphs, introduction to limit and continuity at a point, derivatives, introduction to nth derivatives and Leibnitz's theorem, mean value theorems, Taylor's and maclaurin's series, indeterminate forms and L'Hospital's rule, curvature and radius of curvature, introduction to partial derivatives and Euler's theorem, differentials, tangent and normal, extreme values and its applications, integral calculus with applications, definite integral, proper and improper integrals. Vector Algebra and Vector Calculus.

Introduction to differential equations, classification and formation of differential equations, initial and boundary value problems, solution of linear ordinary differential equations of first order, trajectory and orthogonal trajectory. Solution of homogeneous linear differential equation with constant coefficients of order n, solution of non-homogeneous linear differential equation with constant coefficients of order n, solution of Cauchy Euler equations. Applications of first and second order differential equations in engineering.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

Text and Reference Books:

[1] Calculus	Bradley and Karl J.Smith
[2] Advanced Calculus	Gerald B.Folland
[3] Calculus and Analytical Geometry	Thomas and Finney
[4] Calculus and Analytical Geometry	Dr. S.M. Yousif
[5] Vector Analysis	Dr. S.M. Yousif
[6] Mathematical Method	Dr. S.M. Yousif
[7] Advance Engineering Mathematics	Erwin Kreyszig
[8] Advance Engineering Mathematics	H. K Dass
[9] Differential Equation Series)	Frank Ayres JR (Schaum's Outline Series)

BM103-Physiology

Contact Hours:

Theory =45

Practical=45

Total=90

Credit Hours:

Theory = 3.0

Practical = 1.0

Total = 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain the basic principles of cell and general physiology, nerve and muscle, sensory perception, nervous system, endocrinology, and reproduction.	Cognitive	2	1
2.	Describe the functions associated with nervous, sensory, reproduction and endocrine systems.	Cognitive	2	1
3.	Demonstrate the physiological principles of cell and general physiology, the nervous system, sensory perception, and the endocrine system through laboratory investigations utilizing scientific tools.	Psychomotor	2	1

Course Outline:

1. Introduction to Physiology

- a. The Cell and General Physiology
 - i. Cell structure and function
 - ii. Protein synthesis and cell reproduction
- b. Functional organization of the human body and control of the internal environment
 - i. Homeostasis
 - ii. Feedback mechanisms
- c. Metabolism
 - i. Metabolism of carbohydrates and ATP formation
 - ii. Lipid and protein metabolism, transport through the cell membrane

2. Systems Physiology

- a. Cardiovascular System
- b. Respiratory System
- c. Renal System
- d. Digestive System

3. **Nerve and Muscle Physiology**
 - a. Membrane potential
 - b. Action potential
 - c. Neuronal circuits for processing information
 - d. Contraction of skeletal and cardiac muscles
 - i. Sliding filament mechanism
 - ii. Heart as a pump
4. **Sensory Physiology**
 - a. Sensory Receptors
 - i. Classification and basic mechanisms of action
 - b. Somatic Sensations
 - i. Mechano-receptive sensations
 - ii. Pain
 - iii. Thermal and visceral pain
 - iv. Headache
 - c. Special Senses
 - i. Vision
 - ii. Receptor function of the retina
 - iii. Taste and Smell
 - iv. Chemical senses
5. **Nervous System**
 - a. Organization of the Nervous System
 - b. Basic functions of synapses
 - c. Motor Functions
 - i. Spinal cord and reflexes
 - ii. Cerebral cortex and intellectual functions
 - iii. Motor function of the brainstem
 - iv. Vestibular control of postural reflexes
 - v. Cerebrum and basal ganglia
 - d. Behavioral functions of the Brain
 - i. Limbic system
 - ii. Role of the hypothalamus
 - iii. Control of vegetative functions
 - iv. Autonomic nervous system
 - v. Adrenal medulla
 - vi. Electrical activity from the brain
6. **Endocrinology and Reproduction**
 - a. Introduction to Endocrinology and the Pituitary Hormones
 - i. Overview of endocrine system
 - ii. Functions of pituitary hormones
 - b. Hormonal Functions in Males and Females

- i. Endocrine regulation of reproductive functions
- ii. Hormonal control of male and female reproductive systems

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

- **Laboratory (100%)**

Text and Reference Books:

1. Physiology for Engineers: Applying Engineering Methods to Physiological Systems (Biosystems & Biorobotics) [Michael Chappell and Stephen Payne], latest edition
2. Quantitative Human Physiology: An Introduction [Joseph J Feher], latest edition.
3. John E. Hall, Guyton and Hall Textbook of Medical Physiology, latest edition.
4. Elaine N. Marieb, Essentials of Human Anatomy & Physiology, latest edition.
5. Arthur B.Ritter, Physiology for Engineers: A Systems Approach, latest edition.

ES105- Circuit Analysis

Contact Hours:

Theory = 45
Practical = 45
Total = 90

Credit Hours:

Theory = 3.0
Practical = 1.0
Total = 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Discuss the relevant laws and theorems of DC and AC circuits	Cognitive	2	2
2.	Solve problems related of DC and AC circuits using relevant laws and theorems	Cognitive	2	2
3.	Demonstrate AC/DC circuit laws/ theorems experimentally	Psychomotor	4	2

Course Outline:

DC Circuits

Basic Concepts, Basic laws (Kirchhoff's Laws (KVL and KCL), Delta/Star transformation), Methods of Analysis, Circuit Theorems(AC source Transformation, Thevenin's theorem, Norton's theorem, Reciprocity & Compensation theorems, Maximum Power Transfer Theorem), First order circuits (source free RC, RL circuits) , Second order circuits (source free series and parallel RLC circuits)

AC Circuits

Sinusoids and phasors, sinusoidal steady-state analysis (Nodal analysis, Mesh analysis, Delta/Star transformation, AC source Transformation, Thevenin's theorem, Norton's theorem, Reciprocity & Compensation theorems, Maximum Power Transfer Theorem), AC power analysis (instantaneous power, average power, rms power, complex power), Three-phase circuits (balanced three-phase voltages, unbalanced three-phase circuits)

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester(20%)

Final Semester (60%)

- **Laboratory (100%)**

Sessional (40%)

Lab Rubrics (30%)

Mini Project/ Open ended Lab (10%)

Semester Lab Exam (60%)

Objective type test (20%)

Conduct of Practical/ Viva voce (40%)

Text book & Reference Books:

1. Engineering Circuit Analysis by William Hayt, 8th Edition, 2012. ISBN: 978-0073263182

2. Fundamentals of Electric Circuits by Charles K. Alexander, Matthew N. O. Sadiku. 5th Edition, 2008. ISBN 978-0077263195

MTH107-Communication Skills

Contact Hours:

Theory =45
Practical=00
Total=45

Credit Hours:

Theory = 3.0
Practical = 0.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Apply an enhanced ability in the general verbal and non-verbal English language Communication Skills which can support real life settings requiring team work and leadership skills.	Cognitive	3	10
2.	Demonstrate technical report writing skills affiliated in writing research papers and theses.	Cognitive	3	10

Course Outline:**1. Introduction to Communication Skills**

- Definitions of Communication & Skills
- Communication, its Origin and Development
- Understanding the need and scope of Communication in organizations
- Principles of effective Communication & Building goodwill
- Seven Cs of Communication

2. Components of Communication/Process of communication

- Context
- Sender-Encoder
- Message
- Medium
- Receiver-Decoder
- Feedback

3. Types of Communication Defined

- Oral/Verbal Communication [Small Group Discussions, Presentations, Interviews]
- Written Communication [Preparation of Drafts of Reports, Memorandums, Business Emails, Tenders & Quotations]
- Non-verbal/Body Language Communication [Negative & Positive use of Body Language]

4. Communication at Workplace

- Communication Destination: Internal and External Communication
- Downward Communication
- Upward Communication

- d. Vertical Communication
- e. Horizontal/Lateral Communication
- f. Grapevine Communication
- 5. **Barriers to Communication**
 - a. Semantic/Language Barriers
 - b. Cultural Barriers
 - c. Physical Barriers
 - d. Institutional Barriers
 - e. Communication Apprehension
 - f. Lack of Confidence
 - g. Low Motivation
 - h. Lack of Vocabulary
 - i. Hesitation/Nervousness
 - j. Fear & Anxiety
 - k. Shyness
 - l. Nervousness
- 6. **Presentation Skills/ Strategies**
 - a. Defining the objective, scope and audience of the Presentation
 - b. Material gathering and material organization strategies
 - c. Time Management
 - d. Use of Audio-Visual Aids
 - e. Delivery and Presentation
- 7. **Interviewing Skills**
 - a. Investigating about the company
 - b. Making formal appearance
 - c. Anticipating Questions & Preparing Answers
 - d. Making appropriate Eye contact
- 8. **Introduction to Technical Report Writing**
 - a. Introduction to Report Writing
 - b. Kinds of Reports (Technical, General & Business Reports)
 - c. Purposes of Technical Report Writing
 - d. Characteristics of Technical Report Writing
 - e. Formatting of Technical Report Writing

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

Text and Reference Books:

- [1] Communicate, “Rudolph F. Verderber”
- [2] The Interpersonal Communication Book (14th Edition) 14th Edition “Joseph A. DeVito”.
- [3] Technical Report Writing Today “Pauly and Riordan”
- [4] Effective Presentation Skills: A Practical Guide Better Speaking, Mandel, S.2000. Crisp Publications
- [5] Effective Business Communications, “Murphy, Hildebrandt and Thomas”, 7th Edition
- [6] Basic Communication Skills for Technology “A. J. Rutherford”, 2nd Edition
- [7] Communication Skills for Engineers, “Sunita Mishra and C. Muralikrishna”.
- [8] Communication for Engineering Students, “J. W. Davies.
- [9] Technical Report Writing Toda, Daniel G. Riordan, Wadsworth Publishing 10th Edition

MTH203-Complex Variable & Transform

Contact Hours:

Theory =40

Practical=00

Total=45

Credit Hours:

Theory = 3.0

Practical = 0.0

Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Evaluate complex number and complex variables. Complex differentiation and integration	Cognitive	3	2
2.	Apply Transformations, Laplace and Fourier and their geometrical and physical application	Cognitive	3	2
3.	Use Laplace and Fourier transforms for the solution of differential equations	Cognitive	3	2

Course Outline:

Introduction to complex number system, Argand diagram, modulus and argument of a complex number, polar form of a complex number, De Moivre's theorem and its applications, roots of complex numbers, exponential functions, hyperbolic functions, circular functions, logarithmic function, inverse hyperbolic functions, inverse circular functions. Complex function, Analytic functions, Cauchy-Riemann equations, harmonic functions, singular points, complex differential operators, complex line integrals, Green's theorem in the plane, Cauchy's integral formula, singularities, poles, residues, contour integration, applications of Complex Variable in engineering.

Laplace transform, Laplace transforms of elementary functions, periodic functions and their Laplace transforms. Inverse Laplace transforms solution of ordinary differential equations by Laplace transforms. Fourier Series and Fourier Transforms. Applications of transforms in engineering.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

Text and Reference Books:

- | | |
|---|-------------------------------------|
| [1] Mathematical Method | Dr. S.M. Yousif |
| [2] Complex Variables | Murray (Schaum's Outline Series) |
| [3] Complex Variables and Applications | James Ward Brown, Ruel V. Churchill |
| [4] Complex Variables and Laplace Transform
For engineers | Dover Books |
| [5] Laplace Transform | Spiegel (Schaum's Outline Series) |
| [6] An introduction to Laplace Transforms
And Fourier Transforms | Dyke, Phil |
| [7] Fourier Transforms
(An introduction for Engineers) | Gray, Robert M, Goodman, Joseph |

ES210- Computer Aided Engineering Design

Contact Hours:

Theory = 00
Practical = 45
Total = 45

Credit Hours:

Theory = 0.0
Practical = 1.0
Total = 1.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Define the essential skills on how to use computer aided design software	Psychomotor	2	1
2.	Build through supervision different sort of geometric shapes using AutoCAD software	Psychomotor	3	5
3.	Complete the given task as individual or Team work on special assignment/mini project and discuss the outcome	Affective	3	9

Course Outline:

Introduction to computer-aided design tools such as AutoCAD, OrCAD and PCAD; computer-aided drafting principles and practices; engineering drawing fundamentals using AutoCAD; drawing of electrical machinery and layouts of electronic assemblies, design and layout of circuit boards using software (PCAD or OrCAD).

Suggested Teaching Methodology:

- Lecturing
- Lab tasks
- Report Writing

Suggested Assessment:

- **Laboratory (100%)**
Sessional (40%)
Lab Rubrics (30%)
Mini Project/ Open ended Lab (10%)
Semester Lab Exam (60%)
Objective type test (20%)
Conduct of Practical/ Viva voce (40%)

Text and Reference Books:

1. Shawna Lockhart, "Tutorial Guide to AutoCAD", Prentice Hall, ISBN: 9780131713833.
2. Muhammad H. Rashid, "Introduction to PSpice Using OrCAD for Circuits and Electronics", Prentice Hall, ISBN: 0131019880.

ES208- Digital Logic Design

Contact Hours:

Theory = 45
Practical= 45
Total= 90

Credit Hours:

Theory = 3.0
Practical = 1.0
Total = 4.0

COURSE LEARNING OUTCOME:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain the fundamental concepts of Digital Circuits and describe the operation of logic gates.	Cognitive	2	1
2.	Using the Boolean Algebra, SOP, POS and minimization techniques, implement the digital circuits.	Cognitive	3	2
3.	Analyze the operation of logic gates, combinational and sequential logic circuits.	Cognitive	4	4
4.	Reproduce the circuits based on the operation of logic gates, combinational logic and sequential logic circuits with modern tools.	Psychomotor	3	5
5.	Demonstrate the skills gathered in labs and work as an individual or in teams for developing mini project/ design projects	Affective	3	9

Course Outline:

Introductory digital concepts. Number Systems & Conversion.

- **Logic Gates**

Introduction of Digital Logic Gates. Implementing simple Boolean expressions with logic gates, Concept of universal gates.

- **Boolean Algebra and Boolean Operations**

Boolean algebra operations, Rules, Laws and theorems, Boolean function. Truth table, Boolean expressions. Boolean minimization techniques. Karnaugh Map.

- **Combinational Logic Circuits**

Design of Combinational Logic Circuits, Half and full adders, Half and full subtractors, encoders, decoders, Multiplexer, Demultiplexer, Code Converter, Comparators.

- **Flip Flops**

Latch., SR Latch, SR Flip Flop. JK Flip Master-Slave Flip Flop. Edge triggered flip flop.

- **Digital Circuits**

Implementation of combinational logic circuits, Fan in and Fan-out of logic gates, TTI & CMOS families, Counters, Registers.

- **Semiconductor Memory**

Memory terminology, General memory operation, Read only memories. ROM architecture. Types of ROM Semiconductor RAM, RAM architecture types of RAM.

- **Introduction to Sequential Machines**

Classification of sequential machine. Concept of pulse and level digital signals, Understanding word statement and its key words, State diagram, State table, Flow table, implication table.

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester(20%)

Final Semester (60%)

- **Laboratory (100%)**

Sessional (40%)

Lab Rubrics (30%)

Mini Project/ Open ended Lab (10%)

Semester Lab Exam (60%)

Objective type test (20%)

Conduct of Practical/ Viva voce (40%)

Text and Reference Books:

1. Marcus. M.. "Switching Circuits for Engineers" ISBN : 0138799083.
2. Ronald J. Tocci "Digital Systems Principle & Application" ISBN : 0132123746.
3. Roger L. Tokheim, "Digital Electronics" McGraw Hill Publishing Company, ISBN: 00280044615.
4. Thomas L. Floyd "Digital Fundamentals" .ISBN : 0675205174.
5. William Kleitz "Digital Electronic" (Reference)
6. RP. Jain "Modern Digital Electronics. 3rd Edition" ISBN: 0073404578.

BM202- Human Anatomy

Contact Hours:

Theory =30

Practical=45

Total=75

Credit Hours:

Theory = 2.0

Practical = 1.0

Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain the knowledge about nervous system, Motor functions and endocrinology	Cognitive	2	1
2.	Differentiate the basic anatomical structures and functions associated with the nervous, endocrine, reproductive, and lymphatic systems	Cognitive	4	1
3.	Identify through demonstration the physiological principles of nervous, reproductive, endocrine and lymphatic systems through the scientific tools to carry out laboratory investigations	Psychomotor	3	1

Course Outline:

1. Introduction

- Anatomy and its branches
- Anatomical positions
- Planes
- Topography

2. Cell Anatomy

- Overview of Cellular Anatomy.

3. Extremities (Upper and lower)

- Bones
- Muscles
- Ligaments
- Tendons
- Bursae
- Reticulae
- Capsules
- Arteries
- Veins

- j. Lymphatic system
- 4. Vertebral Anatomy**
 - a. Vertebrae
 - b. Pelvic girdle
 - c. Spinal cord
 - d. Nervous system
- 5. Thorax-Thoracic Viscera**
 - a. Surface anatomy
 - b. Bones surface musculature
 - c. Lungs
 - d. Heart
- 6. Abdomen**
 - a. Organs location
 - b. Structures
 - c. Relations and function
- 7. Head & Neck**
 - a. Bones
 - b. Muscles
 - c. Cranial nerves

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**
 - Sessional (20%)
 - Quizzes/ Test(s) (10%)
 - Assignment(s)/Project/ Presentation (10%)
 - Mid Semester (20%)
 - Final Semester (60%)
- **Laboratory (100%)**
 - Sessional (40%)
 - Lab Rubrics (30%)
 - Mini Project/ Open ended Lab (10%)
 - Semester Lab Exam (60%)
 - Objective type test (20%)
 - Conduct of Practical/ Viva voce (40%)

Text and Reference books:

1. Medical Terminology: A Living Language, Bonnie F. Fremgen and Suzanne S. Frucht, latest edition.
2. New Biology for Engineers and Computer Scientists, Aydin Tozeren and Stephen W. Byers, latest edition.
3. Gerard J. Tortora, Principles of Human Anatomy, latest edition.
4. B. D. Chaurasia, BD Chaurasia's Human Anatomy, latest edition.
5. Frederic H. Martini, Human Anatomy, latest edition.
6. Elaine N. Marieb, Human Anatomy, latest edition.
7. Michael McKinley and Valerie O'Loughlin, Human Anatomy, latest edition.

CS113- Object Oriented Programming

Contact Hours:

Theory =30
Practical=45
Total=75

Credit Hours:

Theory = 2.0
Practical = 1.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Discuss principles of object-oriented paradigm	Cognitive	2	2
2.	Identify the objects & their relationships to build object-oriented solution	Cognitive	3	3
3.	Model a solution for a given problem using object-oriented principles	Cognitive	3	4
4.	Under supervision design and develop computer applications using object-oriented approach	Psychomotor	3	5

Course Outline

1. Introduction

- Traditional trends in Programming, viz. procedural and structured programming.
- Object oriented programming Paradigm.
- Usefulness of OOP Paradigm.
- Characteristics of object-oriented languages.

2. Object Oriented Programming Basics

- Understanding core concepts
- Classes, Implementation of class and Objects.
- Objects as physical objects.
- Encapsulation.
- Directives
- Functions and Overloaded Functions
- Reference arguments
- Abstraction
- Polymorphism
- Object as data types constructor

- k. Object as function arguments.
- 3. **User defined data types, Arrays and String Arrays fundamentals**
 - a. User defined data types.
 - b. Arrays of objects.
 - c. Arrays as class Member Data
 - d. Strings and String arrays.
- 4. **Inheritance**
 - a. Concept of inheritance.
 - b. Derived classes and Base classes.
 - c. Derived Class Constructors.
 - d. Member Functions
 - e. Class hierarchies.
 - f. Public and Private inheritance.
- 5. **Pointers, Streams and Data Filing**
 - a. Addresses and Pointers.
 - b. Address of operator and pointer and arrays.
 - c. Stream classes.
 - d. Stream Errors.
 - e. Disk File I/O with streams.
 - f. File pointers.
 - g. Error handling in I/O files, with member function.
 - h. Overloading the extraction and insertion operators.
 - i. Memory as a stream object.
 - j. Command line arguments, and printer output.
- 6. **Errors and Exceptions**
 - a. A systematic, object-oriented approach to handling errors generated by C++classes.
 - b. Dealing example errors at runtime using Exceptions.
 - c. Understanding Exceptional circumstance of Running out of memory
 - d. Understanding Exceptional circumstance of Problems opening a file.

Practical:

The topic related to theory will be covered in practical.

Teaching Methodology:

- Lecturing, Student Engagement
- Quizzes and Assignments, uploading suggested resources on course website.
- Semester Project

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester (20%)

Final Semester (60%)

- **Laboratory (100%)**

Sessional (40%)

Lab Rubrics (30%)

Mini Project / Open ended Lab (10%)

Semester Lab Exam (60%)

Objective type test (20%)

Conduct of Practical/ Viva voce (40%)

Text and Reference Books:

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

BM203- Biomedical Electronics

Contact Hours:

Theory = 45
Practical= 45
Total= 90

Credit Hours:

Theory = 3.0
Practical = 1.0
Total = 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain working of amplifiers, filter, oscillators, and signal conditioning circuits.	Cognitive	2	1
2.	Analyze electronics circuits used for amplification, wave shaping, and filtration.	Cognitive	4	2
3.	Follow the instructor, to investigate the operation of amplifiers, filters, and oscillators through experiments.	Psychomotor	3	4

Course Outline:

BJT:

BJT as an amplifier; small signal operation; BJT configuration. Multistage Amplifiers.

Power Amplifier:

Class A; class B; class AB; class C; application in biomedical.

Operational Amplifier:

Introduction; inverting and non-inverting configuration; parameters; difference amplifier; summing amplifier; comparators; integrators; differentiators; isolation amplifier; IC LM 741; digital to analog converter.

Filters:

Active; passive; low-pass; high-pass; bandpass; band stop; Chebyshev; Butterworth filters; filters application in biomedical.

Oscillators:

Principle; conditions; Sinusoidal oscillators; non sinusoidal oscillators; 555 timer IC (astable and monostable); application in biomedical.

Introduction to BiCMOS:

Cascaded and cascaded configuration; application in biomedical.

Practical:

Practical's related to theoretical in Biomedical Electronics topics be covered.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

• **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester (20%)

Final Semester (60%)

• **Laboratory (100%)**

Sessional (40%)

Lab Rubrics (30%)

Mini Project/ Open ended Lab (10%)

Semester Lab Exam (60%)

Objective type test (20%)

Conduct of Practical/ Viva voce (40%)

Text and Reference Books:

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

BM204- Biochemistry

Contact Hours:

Theory =30

Practical=45

Total=75

Credit Hours:

Theory = 2.0

Practical = 1.0

Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain the structure, classification and function of basic elements present inside the body, with central dogma of molecular biology and other models.	Cognitive	2	1
2.	Analyze metabolic pathways and activity of biomolecules at cellular level.	Cognitive	2	2
3.	Operate under supervision , to find Blood Glucose level with help of spectrophotometer and demonstrate the amino acid separation methods.	Psychomotor	3	4

Course outline:

1. Basic Concepts of Biochemistry:

Brief review of organic chemistry; overview of cellular structures and processes; acids, bases and buffers; amino acids and peptide bonds; protein structure and function; enzymes; biochemical basis of diseases; use of biochemical measurements for diagnosis.

2. Protein Synthesis through Gene Expression:

Nucleic acid structure: RNA and DNA; the genome; DNA synthesis (replication); RNA synthesis (transcription); protein synthesis (translation); regulation of gene expression; recombinant DNA and biotechnology.

3. Bioenergetics:

Thermodynamics of biological processes; adenosine triphosphate (ATP) and phosphoryl group transfers; oxidation reduction reactions; ATP synthesis via oxidative phosphorylation in mitochondria.

4. Carbohydrate Metabolism:

Carbohydrate structure, glycoconjugates: proteoglycans, glycoproteins, and glycolipids; digestion of carbohydrates; glycogen structure and metabolism; glycolysis; gluconeogenesis; the pentose phosphate pathway; regulation of glycolysis and gluconeogenesis; the citric acid cycle.

5. Lipid Metabolism:

Lipids and membranes; digestion of triacylglycerol; fatty acid and triacylglycerol synthesis; triacylglycerol storage in adipose tissues; cholesterol and bile salt metabolism; blood lipoproteins; fatty acid oxidation; ketone body synthesis and utilization; phospholipid and sphingolipid metabolism.

6. Nitrogen Metabolism:

Protein digestion and amino acid absorption; the urea cycle; synthesis and degradation of amino acids; role of various tissues in amino acid metabolism; molecules derived from amino acids.

Practical:

Practical's related to theoretical in Biomedical Electronics topics be covered.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)

Mid Semester (20%)

Final Semester (60%)

- **Laboratory (100%)**

Sessional (40%)

Lab Rubrics (30%)

Mini Project/ Open ended Lab (10%)

Semester Lab Exam (60%)

Objective type test (20%)

Conduct of Practical/ Viva voce (40%)

Text and Reference Books:

1. Lippincott, Bio-Chemistry, Donald Vote, Judith, G. Vole and Charlotte, W. Prats, latest edition.
2. Fundamentals of Biochemistry, John Wiley & Sons. Rodney Boyer, latest edition.
3. Modern Experimental Biochemistry, Pearsons Education, Delhi, India. Tsai.C. Stan, latest edition.

MTH204-Numerical Analysis & Computer Applications

Contact Hours:

Theory =45
Practical=45
Total=90

Credit Hours:

Theory = 3.0
Practical = 1.0
Total = 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Apply Roots of Algebraic and Transcendental Equations for designing RL, RC and RLC filters. Solution of System of Linear Equations by Iterative Methods use for Analysis of an Electrical Network.	Cognitive	3	2
2.	Solve Interpolation Numerical Differentiation and Numerical Integration.	Cognitive	3	2
4.	Use MATLAB to solve engineering problems numerically.	Psychomotor	3	2

Course Outline:

Introduction to numerical analysis, error analysis, source of error, roots of algebraic and transcendental equations, interval technique where real root lie, Bisection method, Regula falsi method, Secant method, Newton Raphson method, matrix computation, system of linear equations, Jacobi and Gauss-Seidal iterative methods, eigenvalues and eigenvectors, Interpolation and extrapolation, Newton's Forward and Backward Interpolation Formulas, Newton's Divided Difference Formula, Lagrange Interpolation, Numerical Differentiation, Stringling's formula for finite difference, Numerical differentiation of Larrange's polynomial, Numerical integration, trapezoidal and Simpson's rule, Numerical solution of ordinary differential equations, Taylor series solution, Euler's methods, Rungue Kutta methods, Introduction to Numerical solution of Partial differential equations, Applications of Numerical analysis in engineering with computer software ('C'/Matlab).

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

- **Laboratory (100%)**

Text and Reference Books:

[1] Applied Numerical Analysis

Curtis F. Gerald

[2] Numerical Methods for Engineers
Canale

Steven C. Chapra and Raymond P.

[3] Computer Based Numerical Analysis

Dr. M. Shantha kumar

[4] Numerical Analysis

Steven. T. Karris

MTH104- Pakistan Studies

Contact Hours:

Theory = 30

Practical= 00

Total= 30

Credit Hours:

Theory = 2.0

Practical = 0.0

Total = 2.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Describe the historical and ideological perspectives of Pakistan and their implications for individuals and professionals in societal contexts	Cognitive	C2	6
2.	Explain the strategic implications of international conventions and treaties applicable to Pakistan at the national and international level	Cognitive	C2	12

Course Outline:**1. Historical Perspective**

- Ideological rationale with special reference to Sir Syed Ahmed Khan, Alama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.
- Factors leading to Muslim separatism
- People and Land
 - Indus Civilization
 - Muslim advent
 - Location and Geo-Physical features.

2. Government and Politics in Pakistan, Political and constitutional phases

- 1947-58
- 1958-71
- 1971-77
- 1977-88
- 1988-99
- 1999onward

3. Contemporary Pakistan

- Economic institutions and issues
- Society and social structure
- Ethnicity

- d. Foreign policy of Pakistan and challenges
- e. Futuristic outlook of Pakistan
- 4. Foreign Policy**
 - a. Relations of Pakistan with neighbors
 - b. Super powers
 - c. Muslim world
- 5. Human Rights**
 - a. Conceptual foundations
 - b. Local and international issues

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**
 - Sessional (20%)
 - Quizzes/ Test(s) (10%)
 - Assignment(s)/Project/ Presentation (10%)
- Mid Semester (20%)
- Final Semester (60%)

Recommended Text and Reference Books:

1. Burki, Shahid Javed. State & Society in Pakistan, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. Issue in Pakistan's Economy. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. Pakistan's Foreign policy: A Historical analysis. Karachi: Oxford University Press,1993.
4. Mehmood, Safdar. Pakistan Political Roots & Development. Lahore,1994.
5. Wilcox, Wayne. The Emergence of Bangladesh., Washington: American Enterprise, Institute of Public Policy Research,1972.
6. Mehmood, Safdar. Pakistan Kayyuntoota, Lahore: Idara-e-Saqafat-e- Islamia, Club Road,nd.
7. Ziring, Lawrence. Enigma of Political Development. Kent England: Wm Dawson & sons Ltd,1980.
8. Zahid, Ansar. History & Culture of Sindh. Karachi: Royal Book Company, 1980.
9. Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research,1998.

ES221- Signals and Systems

Contact Hours:

Theory = 45
Practical = 45
Total = 90

Credit Hours:

Theory = 3.0
Practical = 1.0
Total = 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Discuss the types of signals and transforms techniques.	Cognitive	2	1
2.	Classify different types of signals and systems.	Cognitive	2	2
3.	Apply Laplace and Fourier Transforms to find the systems stability and frequency response	Cognitive	3	2
4.	Imitate Continuous time filters using modern tools.	Psychomotor	3	5

Course Outline:

- 1. Signal and System Characteristics and Models**
 - a. Concept of Continuous-Time and Discrete-Time Signals and Systems
 - b. Basic Operations on Signals
 - c. Signal and system classifications
- 2. Time-Domain Representation of Continuous-Time Signals**
 - a. Sinusoidal and Complex Exponential Signals
 - b. Singularity Function Signals
 - c. Signal Energy and Power
- 3. Time-Domain Analysis of Continuous-Time Systems**
 - a. System Impulse Response
 - b. Continuous-Convolution Evaluation and Properties
- 4. Frequency-Domain Representation of Continuous and Discrete-Time Signals**
 - a. Spectra and Bandwidths of Continuous-& Discrete Time Signals
 - b. Fourier Series Representation of Signals
 - c. Amplitude and Phase Spectra of Periodic Signals
 - d. The Fourier Transform and Spectra of Aperiodic Signals
 - e. Properties of Fourier transform
- 5. Frequency-Domain Analysis of Continuous-Discrete Time Systems**

- a. System Frequency Response
 - b. Amplitude and Phase Responses
- 6. Analysis of Continuous-Time Systems Using the Laplace Transform**
- a. Laplace Transform Evaluations and Theorems
 - b. Evaluation of Inverse Laplace Transforms
 - c. System Transfer Function and stability
- 7. Continuous-Time Filters**
- a. Distortion-less Transmission
 - b. Ideal Filters
 - c. Approximation of Ideal Filters
 - d. Butterworth and Chebyshev Filter Design

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**
 - Sessional (20%)
 - Quizzes/ Test(s) (10%)
 - Assignment(s)/Project/ Presentation (10%)
 - Mid Semester(20%)
 - Final Semester (60%)
- **Laboratory (100%)**
 - Sessional (40%)
 - Lab Rubrics (30%)
 - Mini Project/ Open ended Lab (10%)
 - Semester Lab Exam (60%)
 - Objective type test (20%)
 - Conduct of Practical/ Viva voce (40%)

Text and Reference Books:

1. Gorden E. Carlson. Signal and Linear System Analysis. John Wiley & Sons, Inc, latest edition.
2. Oppenheim, Alan V., and A. S. Willsky. Signals and Systems. Prentice Hall, latest edition.

BM301- Biomedical Instrumentation-I

Contact Hours:

Theory = 45
Practical= 45
Total= 90

Credit Hours:

Theory = 3.0
Practical = 1.0
Total = 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain the basic concepts related to the classification techniques and working principles of biomedical equipment	Cognitive	2	1
2.	Demonstrate an ability to apply project management skill in developing engineering solutions for different medical issues	Cognitive	5	11
3.	Construct operational prototypes using fundamental components and software tools for various biomedical applications	Psychomotor	3	3
4.	Conceptualize the design of biomedical solutions using sensors, transducers, and biopotentials while assuming responsibility to work effectively as a team member	Affective	4	9

Course Outline:

Types of Biosignals

Various forms of biosignals (bioelectric, biochemical, biomechanical, bio acoustic, bio-optic).

Basic Sensors and Transducers

Active and passive transducers; displacement sensors; inductive and capacitive sensors; piezoelectric sensors; temperature sensors; optical sensors; radiation sensors; electro-chemical sensors; bio sensors; fibre optics.

Medical Instrumentation

Introduction to (medical) instrumentation; accuracy; sensitivity; reproducibility; biocompatibility; classification; measurement constraints; invasive and non-invasive

techniques; design criteria.

Biopotentials and Measurements

Different types of electrodes (EEG, ECG, EMG, ERG, MEG); Application of amplifier and filters in electrocardiograph; vectorcardiograph; phonocardiograph; electroencephalograph; electromyography; apexcardiograph; ballistocardiograph; electrooculograph; electroretinograph. Telemedicine & biotelemetric systems

Measurements and Reporting

Measurements & reporting, graphs, records, time-variant and quantitative variance records; statistical data compiling techniques; real time data transport; future aspects.

Hazards and Safety

Physiological effects of electricity; micro and macro shock hazards; electrical safety codes and standards; basic approaches for protection against shock; protection equipment design; electrical safety analyzers; testing the electric system; testing of electrical appliances

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**
Sessional (20%)
 Quizzes/ Test(s) (10%)
 Assignment(s)/Project/ Presentation (10%)
Mid Semester(20%)
Final Semester (60%)
- **Laboratory (100%)**
Sessional (40%)
 Lab Rubrics (30%)
 Mini Project/ Open ended Lab (10%)
Semester Lab Exam (60%)
 Objective type test (20%)
 Conduct of Practical/ Viva voce (40%)

Recommended Text and Reference Books:

1. Biomedical Instrumentation and Measures by Leslie Cromwell, latest edition.

2. Bio-instrumentation by John G. Webster, latest edition.
3. Medical Instrumentation: Application and Design by John G. Webster. , latest edition.

MTH301-Statistics & Probability

Contact Hours:

Theory =45
Practical=00
Total=45

Credit Hours:

Theory = 3.0
Practical = 0.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Solve different statistical methods to obtain the measure of central values of a data and Analyze Estimations and hypothesis along with regression and correlation analysis.	Cognitive	3	2
2.	Apply the concepts pf Probability and Random variables for discrete and continuous probability distribution.	Cognitive	3	2

Course Outline:

Introduction to statistics and probability, frequency distribution, histogram, polygon, mean, median, mode, standard deviation, variance, correlation, coefficient of correlation, least square method.

Set theory, basic concept of probability, independent events, Baye's theorem, discrete and continuous random variables, distributions and density functions, moments and moments generating functions, probability distributions (binomial, Poisson, normal, uniform and exponential), linear regression and curve fitting, limits theorem, stochastic process, applications.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

Text and Reference Books:

- | | |
|--|---------------------------------|
| [1] Probability for Engineers | Irwin Miller, John E Freund |
| [2] Statistics for Engineers and Scientist
Sincich | William Mendenhall and Terry |
| [3] Introduction to Probability and Statistics | Susan Milton and Jesse C Arnold |
| [4] A First Course in Probability | Sheldon Ross |
| [5] Probability and Random Process for
Electrical Engineers | A. Leon-Garcia |

ES215- Embedded System Design (3+1)

Contact Hours:

Theory =45

Practical=45

Total=90

Credit Hours:

Theory = 3.0

Practical = 1.0

Total = 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain the basics of Embedded Systems. The use of different processors as the fundamental components of the Embedded System, Real-time systems, Instruction set, Memories, Programmable Logic Devices, architectures FPGA as a system, FPGA Fundamentals	Cognitive	2	1
2.	Apply your knowledge about the architectural differences between the various types of processors used for embedded systems, their inherent units and capabilities. Programming and techniques for embedded systems etc. PLD architectures, Programmable arrays logic (PAL). Programmable logic Different FPGA systems and their architecture. FPGA Applications and analyze them according to task requirements.	Cognitive	3	2
3.	Demonstrate the basic circuitry to work with Microcontroller and circuit debugging., the basic circuits into more complicated tasks to enhance understanding of designing and developing Embedded Systems using modern tools.	Psychomotor	3	5

Course Outline:

Introduction to Embedded system and Fundamentals, Trends and challenges in embedded system design, Hardware Design and Implementation, Embedded System Design. Use of single-purpose processors (hardware) and general-purpose processors (software), Memories and Busses Hardware/software Tradeoffs, Advanced

computation models. Control Systems, Chip technologies, PIC Microcontroller, Architecture & Programming and techniques for embedded system along with suitable design examples. Circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging. Introduction to programmable logic devices, PLD arrays Classification of PLDs, PLD architectures the PROM Programmable arrays logic (PAL). Programmable logic PL Digital Design and FPGA. FPGA as system, FPGA Fundamentals. FPGA Applications. Each student will be required to build and debug a micro-controller board. The course will culminate with a significant final project which would extend the base microcontroller board completed earlier in the course and will demonstrate the full knowledge of system in FPGA design.

Practical:

During the laboratory sessions, the students will perform the programming of microcontrollers of different families for using their various peripherals such as timers, counters etc. The students are expected to debug through their code in hardware as well as software. The students will perform the FPGA-based hands-on Practice. In the end, all students are expected to submit a project encompassing what has been learned.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

- **Laboratory (100%)**

Text and Reference Books:

1. David E Simon, “An embedded software primer” Pearson education Asia, Latest edition.
2. Dream teach Software team “Programming for Embedded System” AVR8515 manual
3. Wolf Wayne “FPGA Based System Design” Pearson Education India, Latest edition
4. Andrew Moore “FPGAs for Dummies” 2nd Special Edition
5. Jonathan W. Valvano, “Embedded Microcomputer Systems, Real-Time Interfacing” Prentice Hall, Latest Edition.
6. Richard E. Haskell, “Design of Embedded System Using 68HC12\11 Microcontrollers”, Prentice Hall, Latest Edition

7. Raj Hamal, “Embedded System: Architecture, Programming and Design”, Mc Graw Hill, Latest Edition.

BM308- Biomechanics (3+1)

Contact Hours:

Theory =45
Practical=45
Total=90

Credit Hours:

Theory = 3.0
Practical = 1.0
Total = 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Describe the basic knowledge of moving system mechanics with an overview of anatomical terminology for gross human movements.	Cognitive	2	10
2.	Analyze the analytical problems related to human movements.	Cognitive	4	10
3.	Utilize the common experimental methods of biomechanics, with particular emphasis on movement.	Psychomotor	2	2

Course Outline:**1. Introduction**

- Definition and perspective
- Review of statics
- Review of Dynamics
- Review of deformable body mechanics
- Viscoelasticity, material properties

2. Anthropometry

- Density, mass and inertial properties
- Direct measurement of anthropometric parameters
- Muscle anthropometry
- Mechanical advantage of muscle
- Multipoint muscles

3. Kinematics of Human Movement

- Forms of motion
- Standard reference systems and joint movement terminology
- Spatial reference systems
- Qualitative vs. quantitative analysis of human movement
- Limb-segment angles, joint angle, linear and angular velocities and acceleration
- Tools for direct/indirect measurement of kinematic quantities

4. The biomechanics of Human Bone Growth and Development

- a. Composition and Structure of Bone Tissue
- b. Material Constituents
- c. Structural Organization
- d. Types of Bones
- e. Bone Growth and Development
- f. Longitudinal Growth
- g. Circumferential Growth
- h. Adult Bone Development
- i. Bone Response to Stress
- j. Bone Modeling and Remodeling
- k. Bone Hypertrophy
- l. Bone Atrophy
- m. Osteoporosis

5. Kinetics of Human Movement

- a. Link segment models
- b. Joint reaction forces
- c. Direct Force measurements

6. Biomechanics of upper & lower extremity

- a. Loading and injuries to the shoulder, elbow, wrist joints.
- b. Loading and injuries to the Hip, knee and ankle joints

7. Gait Biomechanics

- a. Methods of gait analysis
- b. Gait cycle
- c. Temporal-spatial parameters
- d. Hip, knee and ankle joint kinematics and kinetics
- e. Interpretation of gait data

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

• **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

• **Laboratory (100%)**

Sessional (40%)

Lab Rubrics (30%)
Mini Project/ Open ended Lab (10%)
Semester Lab Exam (60%)
Objective type test (20%)
Conduct of Practical/ Viva voce (40%)

Text and Reference 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

BM303- Biomedical Signal Processing

Contact Hours:

Theory = 45

Practical= 45

Total= 90

Credit Hours:

Theory = 3.0

Practical = 1.0

Total = 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Describe constraints for discretizing continuous time signal	Cognitive	2	1
2.	Analyze discrete signals using Fourier series, Fourier transforms, and z-transform techniques and should have understanding of formulating and optimizing analysis techniques	Cognitive	4	4
3.	Design and analyze discrete-time systems with the help of various techniques (difference equation, convolution and frequency domain techniques)	Cognitive	6	3
4.	Practice experimental verification of the analytical and design techniques developed for discrete time signals and systems	Psychomotor	3	4

Course Outline:

Overview of Discrete-time Signals and Systems

Sampling, Aliasing, Quantization, Convolution, Correlation, Properties of Discrete time Signals and Systems

Linear Constant Coefficient Difference Equations

Modeling discrete systems, conversion of differential equations into difference equations, solution of difference equations.

Discrete Time Fourier Series

Representation of discrete time periodic signals, signal analysis using discrete time

Fourier series, properties of discrete time Fourier series.

Discrete Fourier Transform

Frequency Domain Sampling, DFT Properties, Inverse DFT, Windowing and DFT Leakage, Direct Computation of DFT

Fast Fourier Transform

Divide and Conquer, Radix algorithms; Inverse FFT, Applications of FFT

Discrete time systems implementation

Overview of z-transform, Analysis of discrete system, Structures of Discrete time systems, Fixed and Floating number types, Quantization effects.

Design of Digital Filters

General Considerations, FIR and IIR Filters, Techniques of FIR and IIR filter Design.

Multirate Signal Processing

Down sampling and Up sampling, Decimation and Interpolation

Biomedical Applications

Detection of Events: ECG rhythm analysis, Maternal Interference in Fetal ECG, EEG wave-shape and wave-complexity: Analysis of event related potentials, coherence analysis, detection of EEG rhythm, PPG wave analysis, Sound wave analysis, EMG Processing

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**
Sessional (20%)
Quizzes/ Test(s) (10%)
Assignment(s)/Project/ Presentation (10%)
Mid Semester (20%)

Final Semester (60%)

- **Laboratory (100%)**

Sessional (40%)

Lab Rubrics (30%)

Mini Project/ Open ended Lab (10%)

Semester Lab Exam (60%)

Objective type test (20%)

Conduct of Practical/ Viva voce (40%)

Text and Reference Books:

1. Biomedical Signal Analysis, Ranagaraj M. Rangayyan, Willey- IEEE Press, latest edition.
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 deVegte.
5. Digital Signal Processing: Fundamentals and Applications. by: Li Tan, latest edition.

BM304- Biomedical Instrumentation II

Contact Hours:

Theory = 45

Practical= 45

Total= 90

Credit Hours:

Theory = 3.0

Practical = 1.0

Total = 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain a range of components, relevant sensors, and used in particular application including Chromatography, spectroscopy, microscopy, Centrifuge machine, and chemistry analyzers	Cognitive	2	1
2.	Illustrate the use of different electronic circuits, software tools, and concept of applied sciences required for the design of biomedical applications.	Cognitive	2	3
3.	Demonstrate the working of various medical equipment, their safety requirements, and risks associated with them to patients	Psychomotor	2	6
4.	Understand the complexity of medical instruments and learn the sustainable solution for effective health care delivery	Affective	4	7

Course Outline:

Blood Pressure Measurement

Direct and Indirect mechanisms, Invasive and non-invasive techniques, Different transducers, and their working, Measuring venous pressure

Cardiac Devices

Cardiac Pacemakers, Fibrillations and Defibrillators, Implantable and External Pacemakers, DC and Implantable defibrillators, Cardiac Output measurement, Indicator Dilution method, Thermal Dilution method, Dye dilution method, Oximeters,

in-vivo and in-vitro oximetry, different types of oximeters.

Instrumentation of Auto Drug Delivery System

Infusion pumps, Components of drug infusion systems, Implantable infusion Systems, Closed loop control in infusion systems.

Hemodialysis Machine

Mechanism of dialysis and dialyzers, Membrane role, Electrical circuits of temperature and conductivity control of dialysate, Ultra-filtration rate monitor, Performance characteristic of dialysis machine.

Ventilator

Parameters of respiration, Artificial ventilation mechanism, Ventilators, Types of ventilators, Ventilator terms Frequency and time dependent graphical representation, Pressure flow diagrams, Modern ventilators

Surgical Instruments, Anesthesia Machine, Lithotripters, Physiotherapeutic and Electrotherapeutic Devices

High frequency heat therapy, Shortwave and microwave diathermy, Ultrasonic therapy, Pain relief theory, Electric stimulation

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

• Theory (100%)

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester (20%)

Final Semester (60%)

• Laboratory (100%)

Sessional (40%)

Lab Rubrics (30%)

Mini Project/ Open ended Lab (10%)

Semester Lab Exam (60%)

Objective type test (20%)

Conduct of Practical/ Viva voce (40%)

Practical:

The topic related to theory will be covered in practical.

Recommended Text and Reference Books:

1. Mary C. Haven (Editor), et al, Laboratory Instrumentation, latest edition
2. Cromwell, Bio-Medical Instrumentation & Measures, latest edition.
3. John G. Webster (Editor), Medical Instrumentation, latest edition.

BM306- Biomedical Control Systems

Contact Hours:

Theory = 45
Practical= 45
Total= 90

Credit Hours:

Theory = 3.0
Practical = 1.0
Total = 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Describe the basic principles of control engineering and designing of control systems through transfer functions, block diagrams and state spaces	Cognitive	2	1
2.	Analyze a control model through investigation of its performance and analysis of its response, errors, and stability	Cognitive	4	4
4.	Under supervision , design a control system, analyze the system response and demonstrate its performance using modern tools.	Psychomotor	3	5

Course Outline:

1. Introduction

- Introduction to control systems
- Open loop and close loop control systems.
- Examples of control systems in Biomedical Engineering.

2. Modeling in the Frequency Domain

- Electrical/Electronic/Mechanical systems transfer function
- Electric circuits analog

3. Modeling in the Time Domain

- General State-Space Representation and Analysis
- Converting a Transfer Function to State Space & vice versa.

4. Time Response

- Poles, Zeros, and System Response
- Transient and steady state response of first and second order systems

5. Reduction of Multiple Subsystems

- Block Diagrams and reduction techniques

- b. Signal-Flow Graphs and Mason's Rule.
- 6. Control System Stability**
 - a. Routh-Hurwitz Criterion and Special Cases
- 7. Root Locus Techniques**
 - a. Root Locus and its Properties
 - b. Sketching the Root Locus plots.
- 8. Frequency Response Techniques**
 - a. Bode and Polar Plots
 - b. Stability via the Nyquist Diagram
 - c. Gain Margin and Phase Margin

Practical:

The topic related to theory will be covered in practical.

Suggested Assessment:

- **Theory (100%)**
 - Sessional (20%)
 - Quizzes/ Test(s) (10%)
 - Assignment(s)/Project/ Presentation (10%)
 - Mid Semester (20%)
 - Final Semester (60%)
- **Laboratory (100%)**
 - Sessional (40%)
 - Lab Rubrics (30%)
 - Mini Project/ Open ended Lab (10%)
 - Semester Lab Exam (60%)
 - Objective type test (20%)
 - Conduct of Practical/ Viva voce (40%)

Text and Reference Books:

1. Control Systems Engineering, by: Norman S. Nise, latest edition.
2. Modern Control Engineering, by: Katsuhiko Ogata, latest edition.
3. Biomedical Applications of Control Engineering, by Selim S. Hacı salihzade, latest edition.

CS321- Modeling and Simulation

Contact Hours:

Theory =30

Practical=45

Total=75

Credit Hours:

Theory = 2.0

Practical = 1.0

Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain Mathematical modelling, its types and the various simulation procedures and how they are used to obtain approximate solutions to dynamic problems in Biomedical Engineering	Cognitive	2	1
2.	Organize the procedures of discrete and continuous time simulations to infer meaningful insights and their impact on real-life scenarios and applications.	Affective	4	7
3.	Analyze Monte Carlo Simulation and Cellular Automata and be able to examine Network and Agent based models	Cognitive	4	4
4.	Apply modelling and simulation to Real-World Events, physiological, electrical, mechanical problems and find solutions of linear and nonlinear equations and the solution of differential equations in life sciences.	Psychomotor	2	11

Course Outline:

Introduction

Modeling and Simulation in Biomedical Engineering, types of Models e.g., graphical model, Quantitative models, Multiscale Models, Hybrid models. Examples and applications using software (MATLAB and R). Conceptual modeling along with its rationale. Conceptual model of cardiorespiratory system, subdivision of Physiology models and combining of basic elements of conceptual models e.g., heart, muscles, eye

etc. Hierarchical and integrated Models.

Mathematical Models

Mathematical Models and their importance in biomedical engineering. Compartmental modelling. Deterministic and Stochastic models and their applications of: (a) Electrical and fluidic modeling of the blood flow through the artery, (b) Elementary Vascular Model and Its Electrical Analog, (c) Electrical modeling of physiological System, (d) Electrode electrolyte interface model, and (e) Hodgkin–Huxley model for cell action potentials

Application of Modeling and Simulation in Physiological System

Examples of Physiological models. Medical imaging and its importance in modeling and Simulation. Mathematical techniques for modeling and simulation including: (i) Modeling of human organs using 3D printing, (ii) Thermal modeling and their applications using Bio heat equations, and (iii) Factors effecting thermal models

Practical:

The topic related to theory will be covered in practical.

Suggested Assessment:

- **Theory (100%)**
 - Sessional (20%)
 - Quizzes/ Test(s) (10%)
 - Assignment(s)/Project/ Presentation (10%)
 - Mid Semester (20%)
 - Final Semester (60%)
- **Laboratory (100%)**
 - Sessional (40%)
 - Lab Rubrics (30%)
 - Mini Project/ Open ended Lab (10%)
 - Semester Lab Exam (60%)
 - Objective type test (20%)
 - Conduct of Practical/ Viva voce (40%)

Text and Reference Books:

1. Modeling and simulation in biomedical engineering, Willem Van Meurs, latest edition.
2. Physiological Modeling: An Introductory Course for Biomedical Engineers , John Enderle, latest edition.

3. Advances in Numerical Heat Transfer, Volume 3, W. J. Minkowycz, latest edition.
4. Introduction to Modeling in Physiology and Medicine, Claudio Cobelli and Ewart Carson, , latest edition.
5. Modeling and Simulation in Medicine, Frank C. Hoppensteadt, Charles S. Peskin, latest edition.

MTH421- Engineering Management

Contact Hours:

Theory = 30
Practical= 00
Total= 30

Credit Hours:

Theory = 2.0
Practical = 0.0
Total = 2.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain the fundamental engineering management principles	Cognitive	2	11
2.	Describe the knowledge and skills needed to effectively lead a team	Cognitive	2	9
3.	Design decision-making and management engineering methodology to analyze problem	Cognitive	6	3
4.	Evaluate the importance of Total Quality Management	Cognitive	5	4

Course Outline

- 1. Introduction to Engineering Management**
 - a. Role of Engineer in Management;
 - b. Functions of Management
 - c. Planning and Techniques of Management
- 2. Organizational Management Engineering**
 - a. Organizing Engineering and Structure
 - b. Establishment of working relationship
 - c. Market for engineering products
 - d. Types of Markets
- 3. Managerial Decision Making and Management of Operations**
 - a. Efficient Managerial Decision in Healthcare setting
 - b. Simulation Modeling of Healthcare delivery
 - c. Simulation Applications in Healthcare setting
 - d. Modeling clinical engineering activities to support healthcare technology management
- 4. Management and Supervision**
 - a. Principles of Hospital management
 - b. Legal, Professional and Ethical Aspects
 - c. Resources, duties and functions of medical and paramedical staff
 - d. Planning, Knowledge of various Hospital services

5. Cost and Quality Management

- a. New Cost Accounting Model
- b. New Indicators for Hospital Management Based on Personnel Cost
- c. Total Quality Management

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester(20%)

Final Semester (60%)

Recommended Books:

1. Buchbinder Sharon, Introduction to Healthcare Management Latest edition.
2. Alexander Kolker, Management Engineering for Effective Healthcare Delivery: Principles and Applications,2012
3. Kaluzny, Warner, Warren, Zelman, Management of Health Services
4. Sakharkar Sharon B, Principles of Hospital Administration & Planning,2009

MTH423- Professional Practices and Ethics

Contact Hours:

Theory = 30
Practical= 00
Total= 30

Credit Hours:

Theory = 2.0
Practical = 0.0
Total = 2.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Discuss the contemporary frameworks of professional and engineering ethics in the light of ethical theories and dilemmas.	Cognitive	2	8
2.	Apply principles, theories, and codes of ethics in situations related to professional practice.	Cognitive	3	8
3.	Value professional, aspirational, and collective ethics for continual professional development.	Affective	3	8

Course Outline:

1. Professional Practices

- Overview of professional practices in Biomedical Engineering.
- Engineering management in biomedical engineering
- Relationship between Professional biomedical engineering Practice and Engineering Management

2. Engineering Project Lifecycle

- Definition of project
- Difference between engineering project and business process
- Skills set for a project manager

3. Management

- Need of managing engineering projects
- Scope of Management
- Resource and Cost Management
- Quality Management
- Risk Management

4. Quality

- Definition of Quality
- Quality Vs. Grade
- Quality Management Process

- d. Defining SLAs for an engineering project
- e. Performance Reporting

5. Planning

- a. Engineering Projects Planning
- b. Monitoring and Controlling
- c. Cost Estimates and Budget Constraints

6. Professional Ethics

- a. Ethical responsibilities of Biomedical Engineers and Moral Complexities.
- b. Health-Ethics
- c. WHO's Health Policies
- d. Codes of law of renowned societies for engineers
- e. Code of law of Biomedical engineering society
- f. Biomedical Engineers Pakistan code of ethics
- g. Ethical challenges for Biomedical Profession.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester (20%)

Final Semester (60%)

Recommended Text and Reference Books:

1. Evans, J.R. & Lindsay, W.M., The Management and Control of Quality, 2011, West Publishing, latest edition.
2. White, M.A. and Bruton, G.D., The Management of Technology, 2006, Thomson South Western.
3. Meredith & Mantel, Project Management-A Managerial Approach, Prentice Hall, latest edition.

BM401- Medical Imaging

Contact Hours:

Theory =30

Practical=45

Total=75

Credit Hours:

Theory = 2.0

Practical = 1.0

Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain the fundamental concepts related to radiation physics involved in biomedical imaging instruments, image reconstruction and image enhancement	Cognitive	2	1
2.	Demonstrate the fundamental concepts of radiation physics involved in biomedical imaging instruments, image reconstruction and image enhancement along with working mechanism and construction of the radiology equipment/module, including X-ray radiography, fluoroscopy, Ultrasound Imaging, Nuclear medicine, and X-ray Computed Tomography	Cognitive	3	2
3.	Practice the steps shown for image processing in order to execute various tasks.	Psychomotor	3	4
4.	Classify various health issues from the associated medical images and exhibit the steps of image processing techniques.	Affective	4	6

Course Outline:

Introduction: Introduction to medical imaging; overview of major modalities such as Radiography; Ultrasound and Magnetic Resonance Imaging (MRI).

X-Ray

Underlying Physics: Interaction techniques of X-Rays with matter; generation of X-Rays; radiation interaction.

Technical mechanism; Structure and Applications: X-Ray tube design; X-Ray

generator; basics of film/screen radiography; properties of film/screen cassettes; basic theory of film processing; latent image formation; wet and dry processing; propagation model; biological relevant measure for energy transfer; biological damage from ionization. Applications of X-Ray imaging.

Ultrasound

Underlying Physics: Acoustical physics and acoustical waves in human tissue; emphasis on ultrasound transmission in soft tissues; attenuation of sound energy; parameters affecting sound transmission; resolution of sound beams.

Technical Structure: Theory of ultrasound unit; sound reflection; refraction; scattering and attenuation; piezoelectric transducers; ultrasound beam; resolution; focusing and steering; Doppler ultrasound & limitations; ultrasound bioeffects and safety; quality and safety assurance for diagnostic ultrasound devices.

Computed Tomography (CT)

Basic principles; system components; working of scanning systems; different generations of CT scans; detectors; processing unit and display.

Magnetic Resonance Imaging (MRI)

Underlying Physics: Fundamentals of magnetism and magnetic resonance; proton density; Larmor frequency; free induction decay; principles of magnetic resonance; magnetic properties of tissues.

Technical Structure: Principles of magnetic resonance imaging; pulse sequence; measurement parameter and image contrast; artifacts; motion reduction artifact techniques; multi-planar acquisition; MR safety; quality assurance; applications.

Nuclear Medical Imaging

Radioisotopes in medical diagnosis; the gamma camera; single photon emission computed tomography (SPECT); positron emission tomography (PET scanner).

Digital Image Processing

Digital image representation, reading images, displaying, writing, data classes, indexing, filtering, image restoration, compression, and segmentation

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments

- Report Writing

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester (20%)

Final Semester (60%)

- **Laboratory (100%)**

Sessional (40%)

Lab Rubrics (30%)

Mini Project/ Open ended Lab (10%)

Semester Lab Exam (60%)

Objective type test (20%)

Conduct of Practical/ Viva voce (40%)

Text and Reference Books:

1. Bush berg J.T., The Essential Physics of Medical Imaging 3rdEd.
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

ES410- Power Electronics

Contact Hours:

Theory =45

Practical=45

Total=90

Credit Hours:

Theory = 3.0

Practical = 1.0

Total = 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Discuss the concept of solid-state power electronic devices used in industries.	Cognitive	2	1
2.	Analyze the behavior of power electronic devices such AC-DC Converters, AC-AC Converters, DC-DC Converters, and DC-AC Converters in power electronic circuits.	Cognitive	4	2
3.	Make the setup for development of power electronic circuit such as controlled rectifier, inverter, DC chopper, cycloconverter and AC regulator and motor controlling using power electronic trainer board	Psychomotor	3	4

Course Outline:

1. Introduction to power electronics

- History of power electronics
- Applications
- Power electronic devices
- Triggering devices
- Manufacturers datasheet
- Device protection

2. Diode circuits and rectifiers

- Diodes with RLC loads
- Freewheeling diodes
- Single phase rectifiers
- Poly phase rectifiers

3. Thyristor commutation

- Natural commutation
- Forced commutation
- Commutation circuit design

4. Controlled rectifiers

- Phase controlled converter operation
- Semi-converter

- c. Full converter
 - d. Dual converter
 - e. Series converters
 - f. Power factor improvement
 - g. Design converter circuits
 - h. Effects of inductances
- 5. Static switches**
- a. Single phase AC switches
 - b. Poly phase AC switches
 - c. DC switches
 - d. Design of static switches
- 6. AC voltage controllers**
- a. Single phase controllers
 - b. Poly phase controllers
 - c. Transformer tap changers
 - d. Cyclo converters
 - e. Design of AC voltage controller circuits
 - f. Effects of inductances
- 7. DC choppers**
- a. Introduction
 - b. Step-down and step-up chopper operation
 - c. Switching mode regulators
 - d. Thyristor chopper circuits
 - e. Chopper circuit design
- 8. Inverters**
- a. Principles of operation
 - b. Single phase inverters
 - c. Polyphase inverters
 - d. Voltage control of inverters
 - e. Harmonic reductions
- 9. Cycloconverters**
- a. Single phase cycloconverter circuits
 - b. Three phase cycloconverter circuits
- 10. DC motor drive applications**
- 11. Voltage source converters and control**
- 12. Waveform analysis, harmonic minimization, PWM AC motor drives**
- 13. Power electronic applications in power systems**

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)

Mid Semester (20%)

Final Semester (60%)

- **Laboratory (100%)**

Sessional (40%)

Lab Rubrics (30%)

Mini Project/ Open ended Lab (10%)

Semester Lab Exam (60%)

Objective type test (20%)

Conduct of Practical/ Viva voce (40%)

Text and Reference Books:

1. N. Mohan, T. M. Undeland, and W. P. Robbins, Power Electronics: Converters, Applications, and Design, Media Enhanced, latest edition, John Wiley & Sons, Inc.
2. M. H. Rashid, Power Electronics: Circuits, Devices, and Applications, Prentice Hall, latest edition.
3. M. D. Singhand K. B. Khanchandani, 'Power Electronics', Tata McGraw- Hills Publishing Company Limited, latest edition.

BM411- Final Year Design Project-I

Contact Hours:

Theory = 00
Practical = 135
Total = 135

Credit Hours:

Theory = 0.0
Practical = 3.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Justify project scope and objective through fundamental engineering knowledge	Cognitive	5	1
2.	Identify specific biomedical engineering problem and outline objectives	Cognitive	4	2
3.	Follow established methodology to design/develop solution for specific biomedical engineering problem	Psychomotor	3	3
4.	Reproduce previous design and experiments related to the biomedical engineering project for validation	Psychomotor	3	4
5.	Reproduce the benchmark of the biomedical engineering project in a simulation environment by using modern IT tools	Psychomotor	3	5
6.	Display the awareness of the social impact assessment of the biomedical engineering project relevance to the societal, health, safety, legal and/or cultural issues	Affective	4	6
7.	Integrate strong alignment of the biomedical engineering project to the sustainable development goals (SDGs)	Affective	4	7
8.	Adhere to ethical behavior in accordance with the code of ethics and requirements of the biomedical engineering project	Affective	4	8
9.	Display effective teamwork and continuous collaboration with the group members	Affective	4	9
10.	Display effective and well-structured presentation skills with thorough and comprehensive responses of questions from technical and non-technical audiences regarding the biomedical engineering project	Affective	4	10
11.	Write the feasibility and resource planning report of the biomedical engineering project considering technical, economic, environmental, and societal factors	Cognitive	6	11

BM307- Biomaterials

Contact Hours:

Theory = 45
Practical= 45
Total= 90

Credit Hours:

Theory = 3.0
Practical = 1.0
Total = 4.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Describe the fundamental concepts and principles of biomaterials, their types and structures, characteristics of biomaterials, material fabrication techniques and their testing	Cognitive	2	1
2.	Analyze material type based on their performance curves (stress vs strain, phase diagram) and provide solutions for existing problems associated with biomaterials.	Cognitive	2	3
3.	Apply knowledge from basic concepts of materials to propose a solution using sustainable or degradable materials for better environmental impact.	Cognitive	3	7
4.	Use modern tools for characterization of biomaterials	Psychomotor	1	5

Course Outline:**Overview**

Historical development and impact of biomaterials.

Structure and Properties of Materials

Crystalline and non-crystalline materials; atomic molecular and crystal structure of solids; atomic binding in solid; crystal imperfections; mechanical properties and testing of materials; heat treatments; surface properties and improvement.

Metals

Introduction to ferrous and non-ferrous metals; steel and its alloys; rare earth metals; types of nonferrous alloys; corrosion and degradation of materials; biocompatibility of

materials.

Ceramics

Introduction to ceramics; structure and properties; surface reactive ceramics; analysis of ceramic surfaces.

Polymers and Biopolymers

Polymers in biomedical use; polyethylene; polypropylene; perfluorinated; acrylic; hydrogels; polyurethanes; polyamides; biodegradable synthetic polymers; silicone rubber; plasma polymerization; microorganisms in polymeric implants; polymer sterilization. Introduction; collagens; elastin; mucopolysaccharides; proteoglycans; cellulose and derivatives; chitin; other polysaccharides.

Composites Material

Anisotropy; particulates; fibrous and porous materials; biocompatibility.

Applications of Biomaterials in Different Fields of Medicine

Strength of biological tissues; performance of implants; tissue response to implants; safety and efficacy testing; tissue grafts; soft tissue applications; cardiovascular implants and extracorporeal devices; biomaterials in ophthalmology; orthopedic implants; dental materials.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**
 - Sessional (20%)
 - Quizzes/ Test(s) (10%)
 - Assignment(s)/Project/ Presentation (10%)
 - Mid Semester (20%)
 - Final Semester (60%)
- **Laboratory (100%)**
 - Sessional (40%)
 - Lab Rubrics (30%)
 - Mini Project/ Open ended Lab (10%)
 - Semester Lab Exam (60%)
 - Objective type test (20%)
 - Conduct of Practical/ Viva voce (40%)

Recommended Texts and Reference Books:

2. Buddy D. Ratner, et al, Biomaterials Science, An Introduction to

- Materials in Medicine, latest edition.
3. Handbook of Biomaterial Properties (Second Edition) edited by William Murphy, Jonathan Black, Garth Hastings, latest edition.
 4. Michael N. Helmus (Editor), Biomaterials in the Design and Reliability of Medical Devices, latest edition.
 5. David Hill, Design Engineering of Biomaterials for Medical Devices
 6. Jos Vander Sloten (Editor), Computer Technology in Biomaterials Science and Engineering (Biomaterials Science & Engineering), latest edition.
 7. Kay C. Dee, et al, An Introduction to Tissue-Biomaterial Interactions, latest edition.
 8. Joon B. Park, Joseph D. Bronzino, Biomaterials Principles and Application, latest edition.
 9. Xian, Wujing, A laboratory course in biomaterials, latest edition.
 10. Mahapatro, Anil, Polymers for biomedical applications, latest edition.
 11. Temenoff, J. S, Biomaterials: The intersection of biology & materials science, latest edition.

MTH424- Entrepreneurship

Contact Hours:

Theory = 30
Practical= 00
Total= 30

Credit Hours:

Theory = 2.0
Practical = 0.0
Total = 2.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain basic functions and importance of entrepreneurship	Cognitive	2	12
2.	Value business ethics on entrepreneurial activities.	Affective	3	8
3.	Demonstrate the entrepreneurial skills to develop business plan	Affective	3	11

Course Outline:

Understanding the Entrepreneurship Mind-set, The revolution impact of Entrepreneurship, The individual Entrepreneurship Mind-set, Corporate Entrepreneurship Mind-set, The Social and Ethical perspectives of Entrepreneurship, Launching Entrepreneurship Ventures, Creativity and innovations, Methods to initiate ventures, Legal challenges in Entrepreneurship, The search for Entrepreneurship Capital, Formulation of Entrepreneurship Plan, The assessment of function with opportunities, The marketing aspects of new ventures, Financial statements in new ventures, Business plan preparation for new ventures, Strategic Perspectives in Entrepreneurship, Strategies growth in Entrepreneurship, Valuation challenges in Entrepreneurship, Final harvest of a new venture

Suggested Teaching Methodology:

- Lecturing
- Guest lectures
- Project

Suggested Assessment:

- **Theory (100%)**
Sessional (20%)
Quizzes/ Test(s) (10%)
Assignment(s)/Project/ Presentation (10%)
Mid Semester (20%)
Final Semester (60%)

Text and Reference Books:

1. “Entrepreneurship (5th Edition), Robert D. Hisrich & Michael P. Peters. McGraw-Hill Irwin. Product Design & Development, Karl T Ulrich & Steven D. Eppinger.
2. Case studies and others will be placed with the photocopier and soft copies of presentations will be uploaded on LMS.
3. Technology Ventures (2013 Edition), Richard C. Dorf & Thomas H. Byers

BM412- Final Year Design Project-II

Contact Hours:

Theory = 00

Practical= 135

Total= 135

Credit Hours:

Theory = 0.0

Practical = 3.0

Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Evaluate the technical analysis of the project to reach the substantiated conclusion	Cognitive	5	2
2.	Devise and implement design layout and process of biomedical engineering project	Cognitive	6	3
3.	Produce experiments related to the biomedical engineering project	Psychomotor	3	4
4.	Display the awareness of the social impact assessment of the biomedical engineering project relevance to the societal, health, safety, legal and/or cultural issues	Affective	4	6
5.	Integrate strong alignment of the biomedical engineering project to the sustainable development goals (SDGs)	Affective	4	7
6.	Adhere to ethical behavior in accordance with the code of ethics and requirements of the biomedical engineering project	Affective	4	8
7.	Display effective teamwork and continuous collaboration with the group members	Affective	4	9
8.	Display effective and well-structured reporting and presentation skills related to biomedical engineering project	Affective	4	10
9.	Follow effective project monitoring and control through engineering principles for a problem related biomedical	Psychomotor	3	11
10.	Identify the importance of biomedical engineering project in the context of innovation and technological developments for continuous improvement in the lifelong learning aspect.	Affective	4	12

BM431- Medical Device Quality System and Standards

Contact Hours:

Theory =45
Practical=00
Total=45

Credit Hours:

Theory = 3.0
Practical = 0.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain the quality management system of medical devices.	Cognitive	2	1
2.	Demonstrate the management responsibility and product realization process of medical devices.	Cognitive	3	1

Course Outline:

1. **Quality Management System**
 - a. Term and Definition
 - b. General Requirements
 - c. Quality Manual
 - d. Control of Documents
 - e. Controls of Records
2. **Management Responsibility and Resource**
 - a. Management commitment Requirement
 - b. Planning
 - c. Responsibility, Authority, and Communication.
 - d. Provision of Resources
 - e. Infrastructure and work environments
3. **Product Realization**
 - a. Planning of Product Realization
 - b. Customer Related Processes
 - c. Design and Development
 - d. Purchasing
 - e. Production and Service Provision
 - f. Validation of Processes of Production
 - g. Identification and Traceability
 - h. Control of Monitoring and Measuring Device

Suggested Teaching Methodology:

- Lecturing

- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

Text and Reference Books:

[1] A Complete Guide to Quality Management in the Medical Device Industry by Itay Abuhav, latest edition.

BM432- Biomedical Engineering Systems

Contact Hours:

Theory =45
Practical=00
Total=45

Credit Hours:

Theory = 3.0
Practical = 0.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Describe the basic knowledge of biomedical engineering system design including classification, design process, design procedures implementation of medical devices	Cognitive	2	1
2.	Demonstrate the complete design process of biomedical engineering systems starting from generating ideas to the manufacturing supply chain	Cognitive	3	1

Course Outline:

- 1. Introduction**
 - a. What is Design?
 - b. The design life cycle
 - c. Medical devices definitions
- 2. Classifying Medical Devices**
 - a. Classification Rules
 - b. Classification Case study
 - c. Classification Models
 - d. Classification and the Design process
- 3. The Design Process**
 - a. Design Process versus Design Control
 - b. Design Models
 - c. Managing Design
 - d. Cross Reference with Regulatory Requirements
- 4. Implementing Design Procedures**
 - a. Audit/Review Procedure
 - b. The Design Process
 - c. Implementing a Procedure
- 5. Developing Your Product Design Specification**

- a. Developing the Statement of Need
- b. The Product Design Specification
- c. Finding, Extracting and Analyzing the Content
- 6. Generating Ideas and Concepts**
 - a. Creative Space
 - b. Generating Concepts/Ideas
 - c. Selecting Concepts and Ideas
- 7. Quality in Design**
 - a. Optimization
 - b. Design of Experiments
 - c. House of Quality
 - d. Failure Mode and Effect Analysis
 - e. D4X
 - f. Six Sigma
- 8. Design Realization/Detailed Design**
 - a. The process to Design Realization
 - b. Assemble Your Detailed Design Team
 - c. Design Calculations
 - d. Materials Selection
 - e. Computer Aided Design
- 9. Evaluation**
 - a. Risk Analysis
 - b. Criteria Based Evaluation
 - c. Computer Based Evaluation
 - d. Value to Healthcare Analysis
 - e. Clinical Studies and Clinical Trials
- 10. Manufacturing Supply Chain**
 - a. Identifying Potential Suppliers
 - b. Packaging
 - c. Procurement
- 11. Labeling and Instructions for Use**

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

Text and Reference Books:

- [1] Medical Device Design: Innovation from Concept to Market 1 st Edition by Peter J Ogrodnik(Author)
- [2] Handbook of Medical Device Design Edited by Richard C. Fries
- [3] Reiliable Design of Medical Device, 3rd Edition, by Richard C. Fries
- [4] Medical Device Design for SIX SIGMA by Basem S. EL Haik

BM433- Medical Device Regulatory Affairs

Contact Hours:

Theory =45
Practical=00
Total=45

Credit Hours:

Theory = 3.0
Practical = 0.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Describe major global reference regulations and harmonization efforts for medical devices, regulatory environment in key Asian markets for medical devices.	Cognitive	2	1
2.	Demonstrate general pre-market requirements, the legal logics behind the definition and regulation of advanced products.	Cognitive	3	1

Course Outline:

1. **Introduction to regulatory affairs**
 - a. The role of RA
 - b. Introduction to major global reference regulations and harmonizations
 - c. Overview of regulatory environment in major Asian reference countries
 - d. Future trends in regulatory development
2. **Pre-market requirements**
 - a. Background
 - b. Classifications
 - c. GMP
 - d. Conformity assessment
3. **Advanced products**
 - a. Combination products
4. **Medical Device Errors**
 - a. Human Factors
 - b. Electronic Health Records
5. **Investigational Device Exemptions**
 - a. HDEs
 - b. Medical Device 510(k)
 - c. Pre-Market Approval (PMA) submissions
 - d. de novo review and Product Development Protocol

6. FDA Enforcement

- a. FDA Postmarket Transformation
- b. Medicare Reimbursement
- c. FDA and the Food and Drug laws

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

Text and Reference Books:

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

BM434- Medical Robotics

Contact Hours:

Theory =45
Practical=00
Total=45

Credit Hours:

Theory = 3.0
Practical = 0.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Expalin the fundamental Knowledge of robots including robot kinematics, Differentail relationships, Lagrangian Mechanics, Trajectory planning, and Applications of robotics in Biomedical Engineering.	Cognitive	2	1
2.	Demonstrate mathematically the position and orientation of objects and the relationship between robot joint coordinates and tool position.	Cognitive	3	1

Course Outline:

1. Fundamentals

- a. What is a Robot?
- b. Classification of Robots
- c. What is Robotics?
- d. History of Robotics
- e. Advantages and Disadvantages of Robots
- f. Robot Components
- g. Robot Degrees of Freedom
- h. Robot Joints
- i. Robot Coordinates
- j. Robot Reference Frames
- k. Programming Modes
- l. Robot Characteristics
- m. Robot Workspace
- n. Robot Languages
- o. Robot Applications
- p. Other Robots and Applications
- q. Social Issues

2. Robot Kinematics

- a. Position Analysis
- b. Robots as Mechanisms
- c. Matrix Representation
- d. Homogeneous Transformation Matrices
- e. Representation of Transformations
- f. Inverse of Transformation Matrices
- g. Forward and Inverse Kinematics of Robots
- h. Denavit-Hartenberg Representation of Forward Kinematic Equations of Robots
- i. The Inverse Kinematic Solution of Robots
- j. Inverse Kinematic Programming of Robots
- k. Degeneracy and Dexterity
- l. The Fundamental Problem with the Denavit-Hartenberg Representation
- m. Differential Motions and Velocities

3. Differential Relationships

- a. Jacobian
- b. Differential Motions of a Frame
- c. Interpretation of the Differential Change
- d. Differential Changes between Frames
- e. Differential Motions of a Robot and Its Hand Frame
- f. Calculation of the Jacobian
- g. How to Relate the Jacobian and the Differential Operator
- h. Inverse Jacobian
- i. Design Project
- j. Dynamic Analysis and Forces

4. Lagrangian Mechanics

- a. A Short Overview
- b. Effective Moments of Inertia
- c. Dynamic Equations for Multiple-Degree-of-Freedom Robots
- d. Static Force Analysis of Robots
- e. Transformation of Forces and Moments between Coordinate Frames
- f. Design Project

5. Trajectory Planning

- a. Path vs. Trajectory
- b. Joint Space vs. Cartesian-Space
- c. Basics of Trajectory Planning
- d. Joint space trajectory planning
- e. Cartesian space trajectories

6. Application of Robotic in BME

- a. Introduction to medical robotics
- b. Mechanisms for medical robots
- c. Sensing for medical robots

- d. Actuators for medical robots
- e. Controls for medical robots
- f. Interfaces for medical robots

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

Text and Reference 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

BM435- Rehabilitation Engineering

Contact Hours:

Theory =45
Practical=00
Total=45

Credit Hours:

Theory = 3.0
Practical = 0.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain the domains of rehabilitation engineering.	Cognitive	2	1
2.	Demonstrate limb Prosthetic devices, orthotic devices, devices for visually impaired, and devices for hearing Impairment	Cognitive	3	1

Course Outline:

1. Introduction

- Introduction to rehabilitation engineering and assistive technology (AT)
- Domains of rehabilitation engineering
- Future of rehabilitation engineering

2. Limb Prosthetic Devices

- Classification of amputation
- Prosthetic prescription and fabrication
- Components of upper limb prosthesis
- Components of lower limb prosthesis

3. Orthotic Devices

- Introduction
- Biomechanical principles of orthoses
- Design consideration
- Spinal orthoses
- Limb orthoses

4. Devices for Visually Impaired

- Dimensions of visual impairment and their impact on task performance
- General purpose assistive technology solutions
- Task-specific assistive technologies
- Technology for reading
- Writing and graphic access

5. Devices for Hearing Impairment

- a. Types of hearing impairment
- b. Historical overview of HAT (Hearing assistance technology)
- c. Medical and surgical approaches to restoring hearing function
- d. Assistive listening devices solutions
- e. Environmental adaptations and universal designs

6. Wheelchairs

- a. Manual wheelchairs and electrical power wheelchairs with brief history
- b. User profiles
- c. Basic structural components
- d. Power and drive systems
- e. Control system
- f. Power assisted wheelchairs
- g. Multifunctional wheelchairs
- h. Wheelchair standards

7. Neurorehabilitation

- a. Functional Electrical Stimulation
- b. Transcutaneous Electrical Stimulation
- c. Brain Computer Interface
- d. Assessment methods for neurorehabilitation

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

Text and Reference 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

BM436- Nano Biotechnology

Contact Hours:

Theory =45
Practical=00
Total=45

Credit Hours:

Theory = 3.0
Practical = 0.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain principles governing the effect of size on material properties at the nanoscale, and perform quantitative analysis	Cognitive	2	1
2.	Demonstrate the working knowledge in nanotechnology techniques and also correlate the impact of nanotechnology and nanoscience in a global, economic, environmental, and societal context	Cognitive	3	1

Course Outline:

- The world of small dimensions**
 - Nanoscale Properties (Electrical, Optical, Chemical)
- Nanoscale visualization techniques**
 - Electron microscopy (TEM, SEM, Cryo-SEM)
 - Scanning probe microscopy (AFM, STM)
 - Diffraction techniques (XRD, synchrotron)
- Bionanomaterials**
 - Biological building blocks
 - Bionanostructures (nanofibers, nanotubes, nanocellulose)
- Biological nanomachines**
 - Ribosomes
 - Photosynthesis systems
 - Bionanomotors
- Engineered Nanomaterials**
 - Carbon nanomaterials (fullerenes, graphene, nanotubes, nanofibers)
 - Metal nanoparticles (synthesis, properties and applications)
 - Magnetic nanoparticles (synthesis, properties and applications)
 - Quantum dots, liquid crystals
 - Nanoporous materials (metallic, zeolite, MOFs)
- Microfabrication methods**

- a. Photolithography
- b. Soft lithography
- c. Replication
7. **Nanofabrication methods**
 - a. Top-Down approaches
8. **Nanotechnology by self-assembly**
 - a. Bottom-Up approach: Principles, thermodynamics, interactions, properties
 - b. Supramolecular self assembly
 - c. Protein nanotechnology
 - d. DNA nanotechnology
9. **Microfluidics**
 - a. Surface tension
 - b. Capillarity
 - c. Reynolds number
 - d. Diffusion
 - e. Viscosity
10. **Nanofluidics**
 - a. Nanopores and nanocapillaries
 - b. Debye length
11. **Diffusion in solid phase and drug delivery**
12. **Biological and medical microdevices**
 - a. Lab on chips
 - b. Organ-on chips
13. **Biosensors**
 - a. Fabrication
 - b. Functionalization
 - c. Applications
14. **Nanotechnology safety and the environment**
15. **Impact of nanotechnology on society and industry**

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

Text and Reference Books:

Date of approval from IAB : 20.10.2023 (2nd IAB) Date of approval from BoF: 27.02.2024 (13th BoF)

Date of Approval from BoS: 26.10.2023 (2nd BoS) Date of approval from AC : 18.03.2024 (43rd AC) Page106

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- [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 ixii.
- [6] Gibbs, M. R. J., Nanomagnetic Materials and Devices. In Nanoscale Science and Technology, John Wiley & Sons, Ltd: 2005; pp 203-236. 152
- [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.

BM437- Telemedicine Systems

Contact Hours:

Theory =45
Practical=00
Total=45

Credit Hours:

Theory = 3.0
Practical = 0.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain the basic knowledge of telemedicine and its benefits	Cognitive	2	1
2.	Demonstrate the applications of communication technologies in telemedicine	Cognitive	3	1

Course Outline:

1. Introduction

- Introduction & Benefits of telemedicine

2. Communication technologies in telemedicine

- Communication infrastructure-LAN and WAN technology
- Satellite, Mobile, Internet technology for telemedicine
- Video and audio conferencing
- Medical information storage and management for telemedicine, patient information, medical history, test reports, medical images, diagnosis and treatment
- Hospital information systems, Doctors, paramedics, facilities
- Pharmaceutical, Security and confidentiality of medical records and access control
- Cyber laws, Access to health Care Services, Health Education and Self Care
- Bio-modeling, medical data coding and compression, Functions of DICOM, PACS and HIS for Telemedicine

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

Text and Reference Books:

- [1] Telemedicine: A Guide to Assessing Telecommunications for Health Care, edited by Marilyn J. Field
- [2] Handbook of Telemedicine, edited by Olga Ferrer-Roca, Marcelo C. SosaIudicissa
- [3] Telemedicine and Telehealth: Principles, Policies, Performances and Pitfalls, By Adam William Darkins, Margaret Ann Cary

BM438- Artificial Intelligence

Contact Hours:

Theory =45
Practical=00
Total=45

Credit Hours:

Theory = 3.0
Practical = 0.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Explain the basic knowledge of artificial intelligence with emphasize on search algorithms and the concept of AI agents	Cognitive	2	1
2.	Apply various search algorithms such as uninformed, informed and heuristic	Cognitive	3	1

Course Outline:

- 1. Introduction to Artificial Intelligence**
 - a. Foundations of AI
 - b. Agents and Environments
 - c. Structure of Agents
 - d. Problem Solving Agents
- 2. Problem Solving by Searching**
 - a. Searching for Solutions
 - b. Uninformed Search Strategies
 - c. Informed Search Strategies
 - d. Informed (Heuristic) Search Strategies
- 3. Reasoning and Knowledge Representation**
 - a. Introduction to Reasoning and Knowledge Representation
 - b. Propositional Logic
 - c. First order Logic
 - d. Reasoning with Uncertainty & Probabilistic Reasoning
 - e. Acting Under Uncertainty
 - f. Bayes' Rule
- 4. Learning**
 - a. Decision Trees
 - b. ID3 Algorithm
 - c. Statistical Learning

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

Text and Reference 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.

BM439- Hospital Information System

Contact Hours:

Theory =45
Practical=00
Total=45

Credit Hours:

Theory = 3.0
Practical = 0.0
Total = 3.0

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	Describe concepts, components, applications of Hospital Information System (HIS), and latest developments in Hospital Management and Information Systems	Cognitive	2	1
2.	Demonstrate benefits of Electronic Health Records (EHRs) and use of Decision Support Systems (DSS) in HIS	Cognitive	3	1

Course Outline:

- 1. Introduction**
 - a. Basics of Information Systems
 - b. Rudiments of Healthcare Information Management System
 - c. HIS, Now and future
- 2. Data standards, Handling and Processing**
 - a. Data representation
 - b. Storage Tiers
 - c. Data Structure
 - d. Flow Charts and Work Process Flow Diagrams
 - e. Electronic Health Records (HERs)
 - f. Pros & Cons of Paper medical records
 - g. Functions and Benefits of EHRs
- 3. Subsystems of HIS**
 - a. Health Information Systems in Clinical Settings
 - b. Laboratory Information Systems
 - c. Radiology Information Systems
 - d. Clinical Decision Support Systems (CDSS)
 - e. Healthcare Financial Management
- 4. Network and Communication**

- a. Medical device networking
- b. DICOM
- c. HL7 standards

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory(100%)**

Sessional (20%)

Mid-Semester (20%)

Final-Semester (60%)

Text and Reference 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