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

OUTCOME BASED EDUCATION (OBE) CATALOGUE

Batch 2024 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. These PEOs are to be effective from Batch-24BME and onwards batches.

List of the PEOs

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

1. **PEO 1**

Graduates will engage in professional practice in biomedical engineering or related fields, demonstrating proficiency in applying engineering principles to solve healthcare-related challenges while committing to ethical standards.

2. **PEO 2**

Graduates will pursue continuous professional development, including advanced degrees or certifications, to stay current with emerging technologies and practices in biomedical engineering.

3. **PEO 3**

Graduates will effectively collaborate in interdisciplinary teams, leveraging their engineering expertise to improve healthcare outcomes and address community health challenges responsibly.

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		
	PEO1	PEO2	PEO3
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 Program's Mission	PEOs		
	PEO 1	PEO 2	PEO 3
Vision To provide quality education in the field of biomedical engineering to meet worldwide socio-economic requirements by improving public health	✓	✓	✓
Program 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 with effect from Batch-24BME and onwards.

List of the PLOs

The 11 PLOs of the B.E. Biomedical Engineering program are as follows:

1. **PLO 01: Engineering Knowledge**
   Apply knowledge of mathematics, natural science, engineering fundamentals and Engineering specialization to the solution of complex engineering problems.
2. **PLO 02: Problem Analysis**
   Identify, formulate, conduct 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**
   An 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**
   Conduct investigation of complex engineering problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
5. **PLO 05: Tool Usage**
   Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex Engineering problems, with an understanding of the limitations.
6. **PLO 06: The Engineer and the World**
   Analyze and evaluate sustainable development impacts to society, the economy, sustainability, health and safety, legal frameworks, and the environment while solving complex engineering problems.

7. **PLO 07: Ethics**

   Apply ethical principles and commit to professional ethics and norms of engineering practice and adhere to relevant national and international laws. Demonstrate an understanding of the need for diversity and inclusion.

8. **PLO 08: Individual and Collaborative Team Work**

   Function effectively, as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings.

9. **PLO 09: Communication**

   Communicate effectively and inclusively 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, and make effective presentations, taking into account cultural, language, and learning differences.

10. **PLO 10: Project Management and Finance**

    Demonstrate knowledge and understanding of engineering management principles and economic decision making and apply these to one's own work, as a member and leader in a team, to manage projects in a multidisciplinary environment.

11. **PLO 11: Lifelong Learning**

    Recognize the need for, and have the preparation and ability for i) independent and life-long learning (ii) adaptability to new and emerging technologies and (iii) critical thinking in the broadest context of technological change.

MAPPING OF PLOs

The mapping of PLOs with the PEOs of the B.E. Biomedical Engineering program is given in Table C1. The PLOs are also mapped with the relevant Sustainable Development Goals (SDGs).

Table C1: Mapping of PLOs with the PEOs

Program Learning Outcomes (PLOs)		SDGs	PEOs		
			PEO 1	PEO 2	PEO 3
PLO 01	Engineering Knowledge	SDG-9	✓		
PLO 02	Problem Analysis	SDG-3,4, 9	✓		
PLO 03	Design/Development of Solutions	SDG-3,4, 9	✓		
PLO 04	Investigation	SDG-3,4, 9	✓		
PLO 05	Tool Usage	SDG-9	✓		
PLO 06	The Engineer and the World	SDG-3,4, 9		✓	
PLO 07	Ethics	SDG-5, 10, 16	✓		
PLO 08	Individual and Collaborative Team Work	SDG-5, 10, 16			✓
PLO 09	Communication	SDG-5, 10, 16			✓
PLO 10	Project Management and Finance	SDG-9			✓
PLO 11	Lifelong Learning	SDG-3, 9 13		✓	

Scheme of Studies (B.E. Biomedical Engineering) for 24BME and onwards batches

1st Semester 1st Year					
S. No.	**Code**	**Course Title**	**Theory**	**Lab**	**Combined**
1	MTH111	Applied Physics	2	1	3
2	CS111	Applications of ICT	2	1	3
3	MTH106	Functional English	3	0	3
4	MTH122/ MTH123	Basic Mathematics / Basic Biology	3	0	3
5	BM104	Introduction to Biomedical Engineering	1	0	1
6	MTH105	Islamic Studies	2	0	2
		Total Semester Credit Hours	**13**	**2**	**15**
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	MTH310	Expository Writing	3	0	3
		Total Semester Credit Hours	**15**	**3**	**18**
1st Semester 2nd Year					
S. No.	**Code**	**Course Title**	**Theory**	**Lab**	**Combined**
1	BM203	Biomedical Electronics	3	1	4
2	MTH203	Complex Variable & Transform	3	0	3
3	BM202	Human Anatomy	2	1	3
4	CS113	Object Oriented Programming	2	1	3
5	ES210	Computer Aided Engineering Design	0	1	1
6	EL204	Occupational Health and Safety	1	0	1
		Total Semester Credit Hours	**11**	**4**	**15**
2nd Semester 2nd Year					
S. No.	**Code**	**Course Title**	**Theory**	**Lab**	**Combined**
1	ES208	Digital Logic Design	3	1	4
2	BM204	Biochemistry	2	1	3
3	MTH211	Numerical Analysis	3	0	3
4	MTH104	Pakistan Studies	2	0	2
5	ES221	Signals & Systems	3	1	4
		Total Semester Credit Hours	**13**	**3**	**16**

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	3	1	4
5	MTH302	Engineering Economics	2	0	2
		Total Semester Credit Hours	**14**	**3**	**17**
1st Semester Final Year					
S. No.	**Code**	**Course Title**	**Theory**	**Lab**	**Combined**
1	MTH423	Professional Practices & Ethics	2	0	2
2	BM402	Artificial Intelligence in Medical Imaging	2	1	3
3	ES410	Power Electronics	3	1	4
4	MTH401	Project Management	2	0	2
5	MTH212	Civics & Community Engagements	2	0	2
6	BM411	Final Year Design Project-I	0	3	3
		Total Semester Credit Hours	**11**	**5**	**16**
2nd Semester Final Year					
S. No.	**Code**	**Course Title**	**Theory**	**Lab**	**Combined**
1	BMXXX	Elective-II	3	0	3
2	BM307	Biomaterials	3	1	4
3	BM403	Quality Assurance of Medical Devices and Dosimetry Standards	2	0	2
4	MTH424	Entrepreneurship	2	0	2
5	BM412	Final Year Design Project-II	0	3	3
		Total Semester Credit Hours	**10**	**4**	**14**
		Total Credit Hours	**102**	**28**	**130**

Elective Courses

S. No.	Course Code	Name of Elective Courses	Credit Hours		
			Theory	Lab	Combined
Elective-I					
1.	BM432	Biomedical Engineering Systems	3	0	3
2.	BM435	Rehabilitation Engineering	3	0	3
Elective-II					
3.	BM436	Nano Biotechnology	3	0	3
4.	BM437	Telemedicine Systems	3	0	3
5.	BM434	Medical Robotics	3	0	3
6.	BM440	Hospital Information System	3	0	3

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
1st Semester 1st Year												
MTH111	Applied Physics	C2, P3	C3									
CS111	Applications of ICT	C1, C2				P3		A3				
MTH106	Functional English									C3		
MTH122/ MTH123	Basic Mathematics / Basic Biology	C1, C3/ C2										
BM104	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	C3, P3									
MTH310	Expository Writing							A4		C2, C3		
1st Semester 2nd Year												
BM203	Biomedical Electronics	C2	C4		P3							
MTH203	Complex Variable & Transform		C3									
BM202	Human Anatomy	C2, C4, P3										
CS113	Object Oriented Programming		C2	C3	C3	P3						
ES210	Computer Aided Engineering Design	P2				P3			A3			
EL204	Occupational Health and Safety	C2		C3								
2nd Semester 2nd Year												
ES208	Digital Logic Design	C2	C3		C4	P3			A3			
BM204	Biochemistry	C2	C2		P3							
MTH211	Numerical Analysis		C3, C4									
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	C2	C4, P2									
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
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	
MTH302	Engineering Economics				C4						C5	
1st Semester Final Year												
MTH423	Professional Practices & Ethics							C2, C3, A3				
BM402	Artificial Intelligence in Medical Imaging	C2	C4			P3						
ES410	Power Electronics	C2	C4		P3							
MTH401	Project Management										C2, C5	
MTH212	Civics & Community Engagements						C2					C4
BM411	Final Year Design Project-I	C5	C4	P3	P3	P3	A4	A4	A4	A4	C6	
2nd Semester Final Year												
BMXXX	Elective-II	C2, C3										
BM307	Biomaterials	C2	C3			P1	C3					
BM403	Quality Assurance of Medical Devices and Dosimetry Standards	C2		C5								
MTH424	Entrepreneurship							A3			A3	C2
BM412	Final Year Design Project-II		C5	C6	P3		A4	A4	A4	A4	P3	A4
PLO Frequency		**28**	**19**	**8**	**12**	**10**	**7**	**7**	**5**	**4**	**7**	**5**

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 Credit Hours	Institute's Program Breakup Credit Hours
General Education/ Non-Engineering Domain				
WK-1/ WK-2	Natural Sciences	Math	12-15	12
		Physics	3-9	9
		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	2
		Social Science	2	2
			2	2
	Management Sciences	Professional Practice	2	2
			2	2
	Computer Sciences	Basic Computing	3	3
		Total (subsection)	**Min 38**	**44**
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	21
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	8
		Total (subsection)	**Min 06**	**08**
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	-
		Total (Credit Hours)	**130-136**	**130**

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-2	Natural Sciences	Math	Applied Calculus	3	0	3	4	12
			Complex Variable & Transform	3	0	3		
			Numerical Analysis	3	0	3		
			Statistics & Probability	3	0	3		
WK-1		Natural Science (Physics, Chemistry, Math)	Applied Physics	2	1	3	3	9
			Basic Biology/ Basic Mathematics	3	0	3		
			Biochemistry	2	1	3		
WK-7	Humanities	English	Functional English	3	0	3	2	6
			Expository Writing	3	0	3		
		Culture	Islamic Studies /Ethics	2	0	2	3	6
			Pakistan Studies	2	0	2		
			Professional Practices & Ethics	2	0	2		
		Social Science	Civics & Community Engagements **	2	0	2	2	4
			Engineering Economics	2	0	2		
	Management Sciences	Professional Practice	Project Management	2	0	2	2	4
			Entrepreneurship	2	0	2		
	Computer Sciences	Basic Computing	Applications of ICT	2	1	3	1	3
Total (General Education Domain/ Non-Engineering Domain)							**17**	**44**
Engineering Domain								
WK-2/ WK-4/ WK-5/ WK-6	Computer and Information Sciences	ICT/ AI/ Data Science/ Cyber Security	Object Oriented Programming	2	1	3	2	6
			Artificial Intelligence in Medical Imaging	2	1	3		
WK-2/ WK-3	Engineering Foundation		Introduction to Biomedical Engineering	1	0	1	7	21
			Basic Electronic Engineering	3	1	4		
			Computer Aided Engineering Design	0	1	1		
			Physiology	3	1	4		
			Circuit Analysis	3	1	4		
			Digital Logic Design	3	1	4		
			Human Anatomy	2	1	3		

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	6	22
			Biomedical Instrumentation II	3	1	4		
			Biomedical Control Systems	3	1	4		
			Modelling & Simulation	3	1	4		
			Quality Assurance of Medical Devices and Dosimetry Standards	2	0	2		
			Biomaterials	3	1	4		
WK-1/ WK-2/ WK-3/ WK-4	Multi-disciplinary Engineering Courses		Power Electronics	3	1	4	3	8
			Elective-II	3	0	3		
			Occupational Health and Safety	1	0	1		
WK-6/ WK-7/ WK-8	Final Year Design Project (FYDP)/ Capstone		FYDP-I	0	3	3		6
			FYDP-II	0	3	3		
WK-6/ WK-7/	Industrial Training	Internship (06-08 Weeks)		Mandatory & Qualifying				
Total (Engineering Domain)							**25**	**86**
Total (Credit Hours)								**130**

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		

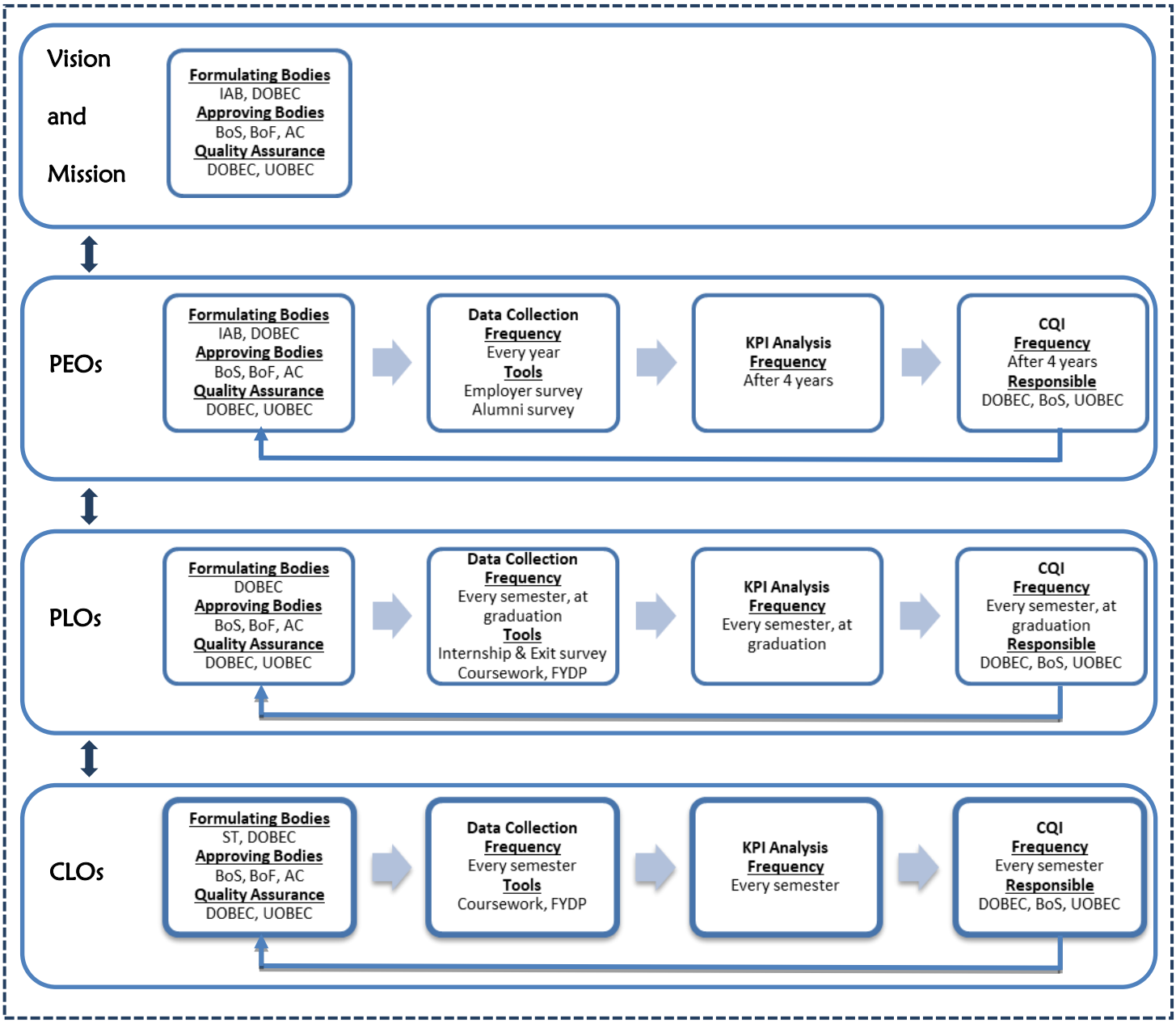
Continuous Quality Improvement (CQI)

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 2. Review of assessment methods 3. Review of the relevant KPIs 4. Review of PEOs	N/A	N/A
PLO	No action required	1. Review of teaching and learning process. 2. Review of PLOs assessment methods. 3. Review of Course-PLO mapping and the relevant KPIs. 4. Review of curriculum design.	1. Review of teaching and learning process. 2. Review of CLOs assessment methods. 3. Review of CLO- PLO mapping and the relevant KPIs. 4. Review of curriculum design.	1. Warning through the progressive attainment sheet. 2. Student counseling.
CLO	No action required	N/A	1. Review of CLO assessment methods. 2. Review of CLOs and taxonomy levels. 3. Review of students' course feedback. 4. Review of CLO KPI 5. Faculty advice by DOBEC. 6. Faculty training	1. Student provided further chances through direct assessment tools. 2. Student counseling.

OBE Implementation Framework

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



Course Profiles for Batch 2024 and onwards

DETAILS OF COURSES
FOR BACHELOR IN BIOMEDICAL ENGINEERING
MTH111-Applied Physics

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** basic laws/ 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. **Vectors**
   a. Review of Vectors
   b. Ordinary Differnetiation of Vectors, Gradient of Scalar field
   c. Divergence and Curl of Vector Field
   d. Line and Surface Integrals with applications
2. **Mechanics**
   a. Newton Laws and their Applications (Simplel Accelerometer, Banked Curve and Rotor)
   b. Frictional Forces and determination of Co-efficient of Friction
   c. Work-Energy Theorem
   d. Applications of Law of Conservation of Energy
   e. Angular Momentum
   f. Centre of Mass of two-particles, many-particles
   g. Solid Object, Rotational Inertia of Solid Bodies
3. **Electrostatistics and Magnetism**
   a. Electric field due to Discreter and Continuous Charge Distribution
   b. Electrostatic Potential of Discrete and Continuous Charges

c. Applications of Gauss's Law
d. Lorentz Force and Hall Effect
e. Ampere's Law
f. Magnetic Field due to Circular Loop and Solenoid
g. Magnetic Dipole
h. Atomic and Nuclear Magnetism
i. Magnetic Materials

4. Semiconductor Physics

a. Energy levels in a Semiconductor
b. Hole concept
c. Intrinsic and Extrinsic regions
d. Law of Mass Action
e. P-N Junction
f. Transistors

5. Wave and Oscillations

a. Simple Harmonic Oscillator
b. Damped Harmonic Oscillation
c. Forced Oscillation and Resonance
d. Types of Wave and Superposition Principle
e. Wave Speed on a stretched string
f. Wave Equation
g. Energy and Power of a Wave

6. Optics and Lasers

a. Huygen's Principle
b. Two-slitt Interference
c. Single-slitt Diffraction
d. Resolving Power of Optical Instruments
e. Principles for LASER Action
f. Types of LASER
g. Applications of LASER

7. **Modern Physics**

a. Planck's explianations of Black Body Radiation
b. Photo-electric Effect
c. Compton Effect
d. De-Broglie Hypothesis
e. Electron Microscope
f. Atomic Structure
g. X-rays and Moseley's Law
h. Atomic Nucleous and Properties of Nucleus
i. Radioactive decay and Radioactive dating

j. Radiation detection Instruments
k. Nuclear Reactions

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. Halliday, Resnick, and Krane, *Physics*, latest edition.
2. Hugh D. Young and RA Freedom, *University Physics*, latest edition.
3. Serway and Jewett, Physics for Scientist & Engineers, latest edition.

CS111- Applications of ICT

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, components and scope of information and communication technologies (ICT).	Cognitive	2	1
2.	**Identify** uses of various ICT platforms and tools for different purposes.	Cognitive	1	1
3.	**Apply** ICT platforms and tools for different purposes to address basic needs in different domains of daily, academic and professional life.	Psychomotor	3	5
4.	**Understand** the ethical and legal considerations in use of ICT platforms and tools.	Affective	3	7

Course Outline:

1. **Introduction to Information and Communication Technologies**
   a. Components of Information and Communication Technologies (Basics of Hardware, Software, ICT Platforms, Networks, Local and Cloud Data Storage, etc.)
   b. Scope of Information and Communication Technologies (Use of ICT in Education, Business, Governance, Healthcare, Digital Media and Entertainment, etc.)
   c. Emerging Technologies and Future Trends
2. **Basic ICT Productivity Tools**
   a. Effective use of Popular Search Engines (e.g. Google, Bing, etc.) to explore World Wide Web.
   b. Fomal Communication Tools and Etiquettes (Gmail, Microsoft Outlook, etc.)
   c. Microsoft Office Suites (Word, Excel, Powerpoint)

d. Google Workspaces (Google Docs, Sheets, Slides)
e. Dropbox (Cloud Storage and File sharing), Google Drive (Cloud Storage with Google Docs with integration) and Microsoft OneDrive (Cloud Storage with Microsoft Office integration)
f. Evernote (Note-taking and Organization applications) and Onenote (Microsoft's Digital Notebook for capturing and organizing ideas)
g. Video Conferencing (Google Meet, Micrsoft Teams, Zoom, etc.)
h. Social Media Applications (LinkedIn, Facebook, Instagram, etc.)

3. ICT in Education

a. Working with Learning Management Systems (Moodle, Canvas, Google Classrooms, etc)
b. Sources of Online Education Courses (Course Era, EdX, Udemy, Khan Academy, etc.)
c. Interactive Multimedia and Virtual Classrooms

4. ICT in Health and Well-being

a. Health and Fitness tracking Devices and Applications (Google Fit, Samsung Health, Apple Health, Xiaomi Mi Band, Runkeeper, etc.)
b. Telemedicine and Online Health Consultations (OLADOC, Sehat Kahani, Marham, etc.)

5. ICT in Personal Finance and Shopping

a. Online Banking and Financial Managment Tools (JazzCash, EasyPaisa, Zong PayMax, 1Link and MNET, Keenu Walle, etc.)
b. E-Commerce Platforms (Daraz.pk, Telemart, Shophive, etc.)

6. Digital Citizenship and Online Etiquette

a. Digital Identity and Online Reputation
b. Netiquette and Respectful Onine Communication
c. Cyber Bullying and Online Harassment

7. **Ethical Considerations in Use of ICT Platforms and Tools**

a. Intellictual Property and Copyright Issues
b. Ensuring Originality in Content Creation by Avoiding Plagiarism and Unauthorized use of Information Sources
c. Content Accuracy and Integrity (ensuring that the content shared through ICT platforms is free from misinformation, fake news, and manipulation)

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] Vernmaat, Shaffer and Freund, *Discovering Computers*, latest edition.
[2] Gaskin, Vergas, and Mclellan, *Go! With Microsoft Office*, latest edition.
[3] Grauer and Poatsy, *Exploring Microsoft Office*, latest edition.
[4] Morley and Parker, *Computing Essentials*, latest edition.
[5] Evans, Martina and Poatsy, *Technology in Action*, latest edition.

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	9
2.	**Apply** skimming, scanning and detailed reading and listening strategies to understand gist of the text/conversation	Cognitive	3	9

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 Semester and determine the middle Semester 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 $R\sin(\theta +- \varphi)$etc.
d. Inverse functions

11. Differential Calculus

a. Limits: Basic concepts
b. Limit of form $\{(\sin\theta)/\theta\} = I$; when θ tends to zero.
c. Exponent functions and type a^xetc.

12. Differentiation

a. Differentiation of χ^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 χsinχ, χe^{χ} and logχ 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
a. Techniques used in Cell Biology
b. Cell Wall and Plasma Membrane – The Boundary Wall
c. Cytoplasm and Organelles
d. Prokaryotic and Eukaryotic Cells

2. Biological Molecules
a. Biological Molecules in Protoplasm
b. Importance of Water (Importance in Protoplasm and in Environment)
c. Carbohydrates
d. Proteins
e. Lipids
f. Nucleic Acids
g. Conjugated Molecules (Glycolipids, Glycoprotein's, Lipoproteins and Nucleoproteins)

3. Enzymes
a. Structure of Enzymes
b. Mechanism of Enzyme Action
c. Factors affecting the Rate of Enzymatic Action (Temperature, pH, Enzyme Concentration and Substrate Concentration)
d. 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

BM104-Introduction to Biomedical Engineering

Contact Hours:
Theory = 15
Practical= 00
Total= 15

Credit Hours:
Theory = 1.0
Practical = 0.0
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.	**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	11
2.	**Discuss** issues related to faith and religious life	Cognitive	3	7

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 Antiderivativs, 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 — 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, 8thEdition, 2012. ISBN: 978-0073263182
2. Fundamentals of Electric Circuits by Charles K.Alexander, Matthew N. O. Sadiku. 5th Edition, 2008.ISBN978-0077263195

MTH310- Expository Writing

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 essentials of the writing process integrating pre-writing drafting, editing and proof reading to produce well-structured essays	Cognitive	2	9
2.	**Demonstrate** mastery of diverse expository types to address different purposes and audience	Cognitive	3	9
3.	**Uphold** ethical practices to maintain originality in expository writing	Affective	4	7

Course Outline:

1. **Introduction to Expository writing**
   a. Understand expository writing (definition, types purpose and applications)
   b. Characteristics of effective expository writing (clarity, coherence and organization)
2. **The Writing Process**
   a. Pre- writing techniques (brainstorming, free writing, mind–mapping listing, questioning and outlining etc.)
   b. Drafting (three stage process of drafting techniques)
   c. Revising and editing (ensuring correct grammar, clarity, coherence, conciseness etc.)
   d. Proof reading (fine –tuning of the draft)
   e. Peer review and feedback (Providing and receiving critique)
3. **Essay Organization and structure**
   a. Introduction and hook (engaging readers and introducing the topic)
   b. Thesis statement (crafting a clear and focused central idea)
   c. Body paragraphs (topic sentences, supporting evidence and transitional devices)
   d. Conclusion (Types of concluding paragraphs and leaving an impact)

e. Ensuring cohesion and coherence (creating seamless connections between paragraphs)

4. **Different Types of Expository Writing**
   a. Description
   b. Illustration
   c. Cause and effect (exploring causal relationship and outcomes)
   d. Process analysis (Explaining step by step procedures)
   e. Comparative analysis (Analysis similarities and differences)
5. **Writing for specific purposes and Audiences**
   a. Different types of purposes (to inform, to analyze to persuade, to entertain etc.)
   b. Writing for academic audiences (formality, objectivity, and persuasive conversations)
   c. Writing for public audiences (engaging informative and persuasive language)
   d. Different tones and styles for specific purposes and audiences
6. **Ethical Considerations**
   a. Ensuring original writing (Finding credible sources evaluating information etc.)
   b. Proper citation and referencing (APLA, MLA, or other citation styles)
   c. Integrating quotes and evidences (quoting, paraphrasing, and summarizing
   d. Avoiding plagiarism (ethical considerations and best practices)

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. Rise Axelrod and Charles R. Cooper, *The St. Martin 'guide to writing*, latest edition
2. Gerald Graff and Cathy Birkenstien, *They Say / I Say: The Moves that matter in Academic Writing,* Latest edition.
3. David Rosenwasser and Jill Stephen, *Writing Analytically*, latest edition.
4. Joseph. Williams and Joseph Bizup , *"Style": Lessons in Clarity and Grace*, latest edition.
5. William stunk Jr. and E.B White, *The Elements of Style,* latest edition.
6. Lester Faigley and Jack Selzer, *Good Reason with Contemporary Arguments*, latest edition.
7. William Zinsser, *Writing to Learn: How to write –and Think –clarity about any Subject at All,* latest edition.

8. Richard Bullock , Maureen Daly Goggin , and Francine Weinberg, *The Norton Field Guide to Writing*, latest edition.
9. Ann Long knife and K.D Sullivan, *The Art of Styling Sentences*, latest edition.
10. Richard Johnson –Sheehan and Charles Paine, *Writing Today*, 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

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 moivres theorem and its applications, roots of complex numbers, exponential functions, hyperbolic functions, circular functions, logarithmic function, inverse hyperbolic functions, 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

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**
   a. Anatomy and its branches
   b. Anatomical positions
   c. Planes
   d. Topography
2. **Cell Anatomy**
   a. Overview of Cellular Anatomy.
3. **Extremities (Upper and lower)**
   a. Bones
   b. Muscles
   c. Ligaments
   d. Tendons
   e. Bursae
   f. Reticulae
   g. Capsules
   h. Arteries
   i. 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

Contac t 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

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

2. Object Oriented Programming Basics

a. Understanding core concepts
b. Classes, Implementation of class and Objects.
c. Objects as physical objects.
d. Encapsulation.
e. Directives
f. Functions and Overloaded Functions
g. Reference arguments
h. Abstraction
i. Polymorphism
j. 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.

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	8

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.

EL204- Occupational Health and Safety (1+0)

Contact Hours:
Theory = 15
Practical = 00
Total = 15

Credit Hours:
Theory = 1.0
Practical = 0.0
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.	**Discuss** Comprehensive Knowledge of Occupational Health and Safety Principles	Cognitive	2	1
2.	**Apply** Risk Management Strategies and Emergency Preparedness	Cognitive	3	3

Course Outline:

1. **Health and Safety Foundations**
   a. Nature and scope of health and safety
   b. Reasons/benefits and barriers for good practices of health and safety
   c. Legal frame work and OHS Management System
2. **Fostering a Safety Culture**
   a. Four principles of safety- RAMP (Recognize, Assess, Minimize, Prepare)
   b. Re-thinking safety-learning form incidents
   c. Safety ethics and rules
   d. Roles and responsibilities towards safety
   e. Building positive attitude towards safety
   f. Safety cultures in academic institutions
3. **Recognize and Communication Hazards**
   a. Hazard and Risk
   b. Types of hazards: Physical (mechanical and non-mechanical), Chemical (Toxic and biological agents), electrical, fire, construction, heat, and temperature, noise and vibration, falling and lifting etc.
   c. Learning the language of safety: Signs, symbols and labels Finding Hazard Information
   d. Material safety data sheets
   e. Safety data sheets and GHS (Global Harmonized Systems)
4. **Accidents & Their Effects on Industry**

a. Cost of accidents
b. Time lost
c. Work injuries, parts of body injured on the job
d. Chemical burn injuries
e. Construction injuries
f. Fire injuries

5. Assessing and Minimizing Risks from Hazards

a. Risk concepts and Terminology
b. Risk assessment procedure
c. Risk Metrics
d. Risk Estimation and Acceptability Criteria
e. Principles of risk prevention
f. Selection and implementation of appropriate Risk controls
g. Hierarchy of controls

6. Preparing for Emergency Response Procedures

a. Fire
b. Chemical Spill
c. First Aid
d. Safety Drills/ Trainings: Firefighting, Evacuation in case of emergency

7. Stress and Safety at Work Environment

a. Work stress and sources
b. Human reaction to workplace stress
c. Measurement of workplace stress
d. Shift work, stress and safety
e. Improving safety by reducing stress
f. Stress in safety managers
g. Stress and workers compensation

8. Incident Investigation

a. Importance of investigation
b. Recording and reporting
c. Techniques of investigation
d. Monitoring
e. Review
f. Auditing Health and Safety

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. Jeremy Stranks, *The A-Z of health and safety*, latest edition.
2. Jeremy Stranks, *The Managers Guide to Health & Safety at Work*, latest edition.
3. Ogeltree, Deakons, Nash, Smoak, and Stewarts, *Occupational safety and health law*, latest edition.

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	8

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.

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.

MTH211- Numerical Analysis

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.	**Perform** Error analysis and interpolation, numerical differentiation and Integration, and methods of solution of a linear equation.	Cognitive	4	2
2.	**Apply** iterative methods for Linear and Non linear equations and numerical methods on IVPs, BVPs, and Computing Eigenvalues	Cognitive	3	2

Course Outline:

1. **Error Analysis and Interpolation**
   a. Error analysis, Types of Error, Sources of Error, norms of Vectors and matrices, Computer arithmetic, Conation number of a matrix, Significant digits and loss of significant digits, Floating point arithmetic, Binary and decimal representation, Single and Double Precision
   b. Interpolation: Newton forward and backward difference formula for interpolation, Central difference interpolation formulae, Lagrange's interpolation., Error in interpolation, Linear least square approximation interpolation versus least square approximation, Relevant engineering case studies
2. **Numerical Differentiation and Integration**
   a. Derivation of numerical differentiation of first order and second order derivatives using two points, three points and five points formulas along with its application in engineering, Relevant case studies.
3. **Methods of solution a system of Linear Equations**
   a. Solution of systems of linear algebraic equations, gauss elimination method
   b. LU factorization, tridiagonal
   c. Application of these methods in engineering disciplines, Relevant case studies
4. **Iterative Methods for Linear and Nonlinear**
   a. Numerical solution of nonlinear equations**:** Bisection method, Newton's Method , Secant method , Convergence analysis of these methods
   b. Newton's method for system of nonlinear equations

c. Solution of system of linear equations by Jacobi, Gauss Seidel and SOR methods, Applications of these methods in engineering disciplines relevant case studies

5. Numerical Methods for IVPs and BVPs

a. Euler's method and its variations, Taylor's higher methods, Error analysis, Consistency, stability and convergence
b. Runge –Kutta methods of order 2,3 and 4, Stiff ODEs, Consistency stability and convergence
c. Linear multistep, Numerical solution of systems of ODEs
d. Numerical solution of BVPs by Difference method

6. Numerical Methods for Computing Eigenvalues

a. Eigenvalues and Eigenvectors of Matrix : Power Method : Application of eigenvalues in engineering disciplines

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. Richard L.Burdern , J. Douglas Faires*, Numerical Analysis*, Latest Edition.
2. R.W hamming, *Numerical Methods for scientist and engineers,* Latest Edition.
3. Steven C. Chapra and R.P Canale, *Numerical methods for Engineers*, Latest Edition.

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	11

Course Outline:

1. Historical Perspective

a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Alama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.

b. Factors leading to Muslim separatism

c. People and Land

- Indus Civilization
- Muslim advent
- Location and Geo-Physical features.

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

a. 1947-58
b. 1958-71
c. 1971-77
d. 1977-88
e. 1988-99
f. 1999onward

3. Contemporary Pakistan

a. Economic institutions and issues

b. Society and social structure

c. 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	10
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	8

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 — William Mendenhall and Terry Sincich
[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 Fundaments	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 devisees, PLD arrays Classification of PLDs, PLD architectures the PROM Programmable arrays logic (PAL). Programmable logic PL Digital Design and FPGA.FPGA as system, FPGA Fundaments. 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	1
2.	**Analyze** the analytical problems related to human movements.	Cognitive	4	2
3.	**Utilize** the common experimental methods of biomechanics, with particular emphasis on movement.	Psychomotor	2	2

Course Outline:

1. **Introduction**
   a. Definition and perspective
   b. Review of statics
   c. Review of Dynamics
   d. Review of deformable body mechanics
   e. Viscoelasticity, material properties
2. **Anthropometry**
   a. Density, mass and inertial properties
   b. Direct measurement of anthropometric parameters
   c. Muscle anthropometry
   d. Mechanical advantage of muscle
   e. Multipoint muscles
3. **Kinematics of Human Movement**
   a. Forms of motion
   b. Standard reference systems and joint movement terminology
   c. Spatial reference systems
   d. Qualitative vs. quantitative analysis of human movement
   e. Limb-segment angles, joint angle, linear and angular velocities and acceleration
   f. 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	6

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
   a. Introduction to control systems
   b. Open loop and close loop control systems.
   c. Examples of control systems in Biomedical Engineering.

2. Modeling in the Frequency Domain
   a. Electrical/Electronic/Mechanical systems transfer function
   b. Electric circuits analog

3. Modeling in the Time Domain
   a. General State-Space Representation and Analysis
   b. Converting a Transfer Function to State Space & vice versa.

4. Time Response
   a. Poles, Zeros, and System Response
   b. Transient and steady state response of first and second order systems

5. Reduction of Multiple Subsystems
   a. 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	6
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	10

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. Hoppen steadt, Charles S. Peskin, latest edition.

MTH302- Engineering Economics

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.	**Justify** strategic economic decision, evaluation project cash flows, and navigating economic uncertainties in engineering projects.	Cognitive	5	10
2.	**Analyze** costs, assess financial viability, and contribute effectively to engineering economic decision- making processes.	Cognitive	4	4

Course Outline:

1. **Engineering Economics**
   a. Role of Engineers in business
   b. Economic decisions v/s design decisions
   c. Large scale engineering projects and types of strategic economic decisions
   d. Fundamentals principles of engineering economics
   e. Interest Rate and Economic Equivalence
   f. Interest: The cost of Money
   g. Economic: Equivalence
   h. Development of Formulas for Equivalence Calculation
2. **Understanding Money and Its Management**
   a. Nominal and Effective Interest Rates
   b. Equivalence Calculations with Effective Interest Rates and with continuous payment
   c. Changing interest Rates
   d. Debt Management
   e. Investing in Financial Assets
3. **Present worth Analysis**
   a. Project cash flows
   b. Initial Projects Screening Methods: payback screening and discounted cash flow Analysis
   c. Variations of present-worth Analysis
   d. Compacting Mutually Exclusive Alternatives
   e. Comparing mutually exclusive Alternatives
4. **Annual Equivalent –Worth Analysis**

a. Annual Equivalent worth criterion
b. Capital costs versus operating costs
c. Applying Annual –worth Analysis
d. Life-cycle cost Analysis
e. Design Economics

5. **Rate of- Return Analysis**
   a. Rate of Return and Methods of Finding it
   b. Internal Rate of-of-return Criterion
   c. Mutually Exclusive Alternatives
6. **Cost Concepts Relevant to Decision Making**
   a. General cost Terms: Classifying Costs for Financial Statements
   b. Cost classifying for predicting cost behavior
   c. Future costs of Business Decisions
   d. Estimating Profit from Production
7. **Depreciation and Corporate Taxes**
   a. Asset Depreciation: Economic Versus Accounting
   b. Book and Tax Depreciation Methods (MACRS)
   c. Depletion
   d. Income Tax Rate to be used in Economic Analysis
   e. The Need for Flow IN Engineering Economic Analysis
8. **Developing Project Cash Flows**
   a. Cash –Benefit Estimation for Engineering Projects
   b. Developing Cash Flow Statements
9. **Project Risk and Uncertainty**
   a. Origins of project Risk
   b. Methods of describing Project Risk: Sensitivity , Break –Even and Scenario Analysis
10. **Special Topics in Engineering Economics**
    a. Replacement Decisions
    b. Capital Budgeting Decisions
    c. Economic Analysis in the service sector

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. Chan S. Park, *Contemporary Engineering Economics*, Pearson, latest edition.
2. Donal G. Newnan Jerome P. Lavelle Ted G. Eschenbach, *Engineering Economic Analysis*, Oxford University Press, latest edition.
3. Leland T. Blank and Anthony Tarquin, *Engineering Economy*, latest edition.

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	7
2.	**Apply** principles, theories, and codes of ethics in situations related to professional practice.	Cognitive	3	7
3.	**Value** professional, aspirational, and collective ethics for continual professional development.	Affective	3	7

Course Outline:

1. Professional Practices
   a. Overview of professional practices in Biomedical Engineering.
   b. Engineering management in biomedical engineering
   c. Relationship between Professional biomedical engineering Practice and Engineering Management

2. Engineering Project Lifecycle
   a. Definition of project
   b. Difference between engineering project and business process
   c. Skills set for a project manager

3. Management
   a. Need of managing engineering projects
   b. Scope of Management
   c. Resource and Cost Management
   d. Quality Management
   e. Risk Management

4. Quality
   a. Definition of Quality
   b. Quality Vs. Grade

c.
d. Quality Management Process
e. Defining SLAs for an engineering project
f. 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 BiomedicalEngineers 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.

BM402- Artificial Intelligence in 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.	**Describe** the fundamental principles of artificial intelligence and machine learning, including key techniques such as deep learning, and their applications in various medical imaging modalities.	Cognitive	2	1
2.	**Analyze** case studies of AI implementations in medical imaging, assessing their impact on diagnostic accuracy, efficiency, and ethical considerations.	Cognitive	4	2
3.	**Implement with Guided Response**, AI algorithms on medical imaging datasets to perform tasks such as image segmentation, classification, and feature extraction, demonstrating proficiency in relevant software tools and techniques.	Psychomotor	3	5

Course Outline:

1. **Introduction to Medical Imaging**
   a. Overview of medical imaging modalities (e.g., X-ray, MRI, CT, ultrasound)
   b. Importance and applications of medical imaging in healthcare
2. **Fundamentals of Artificial Intelligence**
   a. Basic concepts of AI and machine learning
   b. Types of machine learning: supervised, unsupervised, and reinforcement learning
   c. Overview of deep learning and neural networks
3. **Image Processing Techniques**
   a. Preprocessing methods (filtering, normalization, augmentation)

b. Feature extraction techniques
c. Image segmentation methods

4. **AI Techniques in Medical Imaging**
   a. Convolutional neural networks (CNNs) and their applications
   b. Transfer learning in medical imaging
   c. Case studies of AI in diagnostic imaging (e.g., detecting tumors, segmentation of organs)
5. **Data Management and Annotation**
   a. Importance of annotated datasets for training AI models
   b. Methods for data collection, curation, and annotation
   c. Challenges in obtaining and managing medical imaging data
6. **Evaluation of AI Models**
   a. Metrics for assessing model performance (accuracy, precision, recall, F1 score)
   b. Validation techniques (cross-validation, external validation)
   c. Ethical considerations and biases in AI models
7. **Clinical Applications and Case Studies**
   a. Real-world applications of AI in various imaging modalities
   b. Case studies highlighting successful integration of AI in clinical settings
   c. Future trends and innovations in AI for medical imaging
8. **Regulatory and Ethical Issues**
   a. Overview of regulations governing medical AI (e.g., FDA, CE marking)
   b. Ethical considerations in the use of AI in healthcare
   c. Patient privacy and data security concerns
9. **Hands-On Projects and Applications**
   a. Practical assignments using AI tools for medical imaging analysis
   b. Group projects to develop simple AI models for specific imaging tasks
   c. Presentation of project findings and discussions

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. Hamid Laga, et al., *Deep Learning for Medical Image Analysis*, latest edition.
2. Michael J. T. O'Reilly and Andrew C. M. B. MacMahon, *Artificial Intelligence in Healthcare: Opportunities and Threats*, latest edition.

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
- a. History of power electronics
- b. Applications
- c. Power electronic devices
- d. Triggering devices
- e. Manufacturers datasheet
- f. Device protection

2. Diode circuits and rectifiers
- a. Diodes with RLC loads
- b. Freewheeling diodes
- c. Single phase rectifiers
- d. Poly phase rectifiers

3. Thyristor commutation
- a. Natural commutation
- b. Forced commutation
- c. Commutation circuit design

4. Controlled rectifiers
- a. Phase controlled converter operation
- b. 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.

MTH401- Project 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** core issues pertaining to Engineering Project Management.	Cognitive	2	10
2.	**Evaluate** project costing, budgeting and financial appraisal for project planning control and management, using standard tools and schedules variance analysis.	Cognitive	5	10

Course Outline:

1. **Project Management Concepts**

   History of project Management, introduction to project Management, project, program & portfolio management characteristics & Requirements project phases/stage, project Life Cycle project Environment, project Scope & Project charter, project manager, project stakeholder Analysis
2. **Project Proposal Development**

   Project proposal characteristics of good proposal, Types of proposal Request for proposal;. Request for Quotation etc.). Proposal Templates etc.
3. **Project Feasibility**

   Brief review of various aspects of project Feasibility like Technical, social, managerial , Economic , Financial Marketing , administrative etc.
4. **Project Selection Criteria (Economic Analysis of Engineering Projects)**

   Using break Even Analysis, cost Benefit Ratio, Internal Rate of Return, Net Present value etc.
5. **Project Contract & Procurement Management**
   Engineering contracts, types of contracts, understanding of procurement process & cycle, PPRA Rules
6. **Project Planning and Scheduling**

Project planning (Resources & HR Planning), work Breakdown structure project Network & Scheduling, Managing Scheduling and Activity Charts, Critical path method (CPM) Project Evaluation & Review Techniques

7. **Project Cost & Estimating**

   Cost Estimation in projects, cost components in projects and Methods for cost estimation in projects, cost control in projects, estimation of OUTSTANDING WORK, Earned Value Management, schedule & cost variance analysis

8. **Project HRM & Communication Management**

   Effective organization and communication for successful projects, projects organization structures (Project Matrix and Project based organization)
   Project HR Plan preparation, HR Need Assessment and HR Matrix, Building and managing effective communication plan

9. **Project Risk Management**

   Definitions project Risk, Project Risk Management Tools, Types of project Risk, Project Risk Assessment, Risk identification and Mitigation Monitoring & Controlling Risk, Generic Risk Management Strategies & Techniques

10. **Computer Application In Project Management**

    Basic/ Elementary Introduction and hands on basic exposure of use of MS Project & Primavera P6 software in project Management

11. **Project Quality Management**

    Defining Quality, Quality Assurance, Quality Management, 7 Quality Improvement Tools as Applied to Project Management, Project Quality Management plan, Quality Management Processes and strategies

12. **Project Closure & Termination**

    Project Evaluation, defining project success, project completion criteria, Project Audit, Project Termination & when to close a project the termination process project close up
    & lesson learnt, & Project Archive

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. Harold Kerzner, *Project Management : A system to planning Scheduling and Controlling*, latest edition.
2. Bennett, F, Lawrence, *The management of engineering*, New York Willey, latest edition.
3. Cleland David, *Field guide to project management*, New York Willey, latest edition.

MTH212- Civics & Community Engagements

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** essential of Civil Society, Government, and Civic responsibilities.	Cognitive	2	6
2.	**Recognize** the significance of community engagement for the societal harmony and peaceful co- existence.	Cognitive	4	11

Course Outline:

1. **Introduction of civics and Citizenship**
   a. Definition of civics, citizenship, and civic engagement
   b. Historical evolution of civic participation
   c. Types of citizenship: active, participatory, digital etc.
   d. The relationship between democracy and citizenship
2. **Civics and Citizenship**
   a. Concepts of civics, citizenship, and civic engagement
   b. Foundation of modem society and citizenship
   c. Types of citizenship: active, participatory, digital, etc.
3. **State, Government and Civil Society**
   a. Structure and functions of government In Pakistan
   b. The relationship between democracy and civil society
   c. Right to vote and improve of political participation and representation.
4. **Right and Responsibilities**
   a. Overview of fundamental rights and liberties of citizens under constitution of Pakistan 1973
   b. Civic responsibilities and duties
   c. Ethical consideration in civic engagement (accountabilities, nonviolence, peaceful dialogue, civility, etc.)
5. **Community Engagement**
   a. Concert, nature and characteristics of community
   b. Community development and social cohesion

c. Approaches to effective are community engagement.
d. Case studies of successful community driven initiatives

6. **Advocacy and Activism**
   a. Public discourse and public opinion
   b. Role of advocacy in addressing social issues.
   c. Social action movements
7. **Digital citizenship and Technology**
   a. The use of digital platforms for civic engagement
   b. Cyber ethics and responsibilities use of social media.
   c. Digital divides and disparities (access, usage, socioeconomic,
   d. Geographic, etc.) And their impacts of citizenship.
8. **Diversity, Inclusion and social justice:**
   a. Understanding diversity in social (ethnic cultural, economic, political etc.)
   b. Youth women and minorities 'engagement in social development
   c. Addressing social inequalities and injustice in Pakistan
   d. Promoting incisive citizenship and equal rights for social harmony and peaceful co-existence

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. *Civics Todays: Citizenship, Economics, & you*, McGraw-Hill Education, latest edition.
2. Will Kymlicka and Wayne Norman, *Citizenship and diverse societies,* latest edition.
3. James Youniss and peter Levine, *Engaging youth in civic Life,* latest edition.
4. Kristen Mattson, *Digital citizenship in Action: Empowering Students to Engage In online communities,* latest edition.
5. Graham Pike and David Selby, *Globalization and Citizenship: In the pursuit of a composition Education,* latest edition.
6. Becky J. Feldapausch and Susan M. Omilian, *Community Engagement: principles strategies, and practices,* latest edition.
7. Matthew Clarke and Marie- Monique Steckel, *Creating Social Change : A Blueprint for a Better World,* latest edition.
8.

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	6
8.	**Adhere** to ethical behavior in accordance with the code of ethics and requirements of the biomedical engineering project	Affective	4	7
9.	**Display** effective teamwork and continuous collaboration with the group members	Affective	4	8
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	9
11.	**Write** the feasibility and resource planning report of the biomedical engineering project considering technical, economic, environmental, and societal factors	Cognitive	6	10

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	6
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:

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

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

BM403- Quality Assurance of Medical Devices and Dosimetry 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.	**Describe** relevant regulatory standards and guidelines for quality assurance in medical devices, including ISO 13485 and ISO 14971, to ensure compliance and safety in biomedical engineering practices	Cognitive	2	1
2.	**Evaluate** quality assurance processes for medical devices and dosimetry, including the development and implementation of quality control protocols, risk management strategies, and calibration procedures to enhance patient safety and device efficacy.	Cognitive	5	3

Course Outline:

1. **Introduction to Quality Assurance (QA)**
   a. Definition and importance of quality assurance in biomedical engineering
   b. Overview of regulatory bodies and standards (e.g., FDA, ISO, IEC)
2. **Medical Device Regulations and Standards**
   a. Classification of medical devices
   b. Pre-market and post-market regulatory processes
   c. Quality management systems (QMS) and ISO 13485
   d. Risk management according to ISO 14971
3. **Quality Control (QC) Processes**
   a. Difference between QA and QC
   b. Statistical methods for quality control
   c. Process validation and verification

d. Documentation and traceability

4. **Dosimetry Principles**
   a. Overview of radiation and its interaction with matter
   b. Key dosimetric quantities: dose, dose rate, and exposure
   c. Calibration of dosimeters and equipment
5. **Standards in Dosimetry**
   a. International standards for dosimetry (e.g., ICRU, AAPM)
   b. Reference standards and calibration protocols
   c. Quality assurance programs for dosimetry
6. **Quality Assurance in Medical Imaging Devices**
   a. QA protocols for imaging modalities (e.g., X-ray, MRI, CT)
   b. Image quality assessment and optimization
   c. Routine quality control tests and maintenance
7. **Patient Safety and Risk Management**
   a. Understanding patient safety in the context of medical devices
   b. Risk assessment methodologies (e.g., FMEA)
   c. Adverse event reporting and incident investigation
8. **Emerging Technologies and QA Challenges**
   a. Impact of AI and machine learning on QA in medical devices
   b. Challenges in ensuring quality in novel medical technologies
   c. Future trends in medical device quality assurance

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. James R. McNutt and Mary J. Ziegler., *Quality Assurance for the Health Care Industry*, latest edition.
2. Steven M. W. Jones and Gerald A. S. Wong, *Radiation Dosimetry: Measurement, Processing, and Applications*, 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	11
2.	**Value** business ethics on entrepreneurial activities.	Affective	3	7
3.	**Demonstrate** the entrepreneurial skills to develop business plan	Affective	3	10

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	6
6.	**Adhere** to ethical behavior in accordance with the code of ethics and requirements of the biomedical engineering project	Affective	4	7
7.	**Display** effective teamwork and continuous collaboration with the group members	Affective	4	8
8.	**Display** effective and well-structured reporting and presentation skills related to biomedical engineering project	Affective	4	9
9.	**Follow** effective project monitoring and control through engineering principles for a problem related biomedical	Psychomotor	3	10
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	11

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 biomdedical 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

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**
   a. Introduction to rehabilitation engineering and assistive technology (AT)
   b. Domains of rehabilitation engineering
   c. Future of rehabilitation engineering
2. **Limb Prosthetic Devices**
   a. Classification of amputation
   b. Prosthetic prescription and fabrication
   c. Components of upper limb prosthesis
   d. Components of lower limb prosthesis
3. **Orthotic Devices**
   a. Introduction
   b. Biomechanical principles of orthoses
   c. Design consideration
   d. Spinal orthoses
   e. Limb orthoses
4. **Devices for Visually Impaired**
   a. Dimensions of visual impairment and their impact on task performance
   b. General purpose assistive technology solutions
   c. Task-specific assistive technologies
   d. Technology for reading
   e. 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.	**Demostrate** 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:

1. **The world of small dimensions**
   a. Nanoscale Properties (Electrical, Optical, Chemical)
2. **Nanoscale visualization techniques**
   a. Electron microscopy (TEM, SEM, Cryo-SEM)
   b. Scanning probe microscopy (AFM, STM)
   c. Diffraction techniques (XRD, synchrotron)
3. **Bionanomaterials**
   a. Biological building blocks
   b. Bionanostructures (nanofibers, nanotubes, nanocellulose)
4. **Biological nanomachines**
   a. Ribosomes
   b. Photosynthesis systems
   c. Bionanomotors
5. **Engineered Nanomaterials**
   a. Carbon nanomaterials (fullerenes, graphene, nanotubes, nanofibers)
   b. Metal nanoparticles (synthesis, properties and applications)
   c. Magnetic nanoparticles (synthesis, properties and applications)
   d. Quanatum dots, liquid crystals
   e. Nanoporous materials (metalic, zeolite, MOFs)
6. **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:

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

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

[3] Leggett, G. J.; Jones, R. A. L., Bionanotechnology. In Nanoscale Science and Technology, John Wiley & Sons, Ltd: 2005; pp 419-445.

[4] Bucke, C., Bionanotechnology—lessons from nature. By David S Godsell. Wiley-Liss, Hoboken, NJ, 2004. 352 pp, ISBN 0 471 41719 X. Journal of Chemical Technology & Biotechnology 2005, 80 (8), 964-965.

[5] Goodsell, D. S., In Bionanotechnology, John Wiley & Sons, Inc.: 2004; pp 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**
   a. Introduction & Benefits of telemedicine
2. **Communication technologies in telemedicine**
   a. Communication infrastructure-LAN and WAN technology
   b. Satellite, Mobile, Internet technology for telemedicine
   c. Video and audio conferencing
   d. Medical information storage and management for telemedicine, patient information, medical history, test reports, medical images, diagnosis and treatment
   e. Hospital information systems, Doctors, paramedics, facilities
   f. Pharmaceutical, Security and confidentially of medical records and access control
   g. Cyber laws, Access to health Care Services, Health Education and Self Care
   h. 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

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

BM440- 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