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

OUTCOME BASED EDUCATION (OBE) CATALOGUE

Batch 2022

B.E. Biomedical Engineering

Department of Biomedical Engineering

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VISION AND MISSION OF THE UNIVERSITY

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

Vision of the QUEST

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

Mission of the QUEST

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

VISION AND MISSION OF THE DEPARTMENT

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

Vision of the department

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

Mission of the department

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

MAPPING OF VISION AND MISSION

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

Table A: Mapping of Vision and Mission

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

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

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

List of the PEOs

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

1. **PEO_1_BM_22**

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

2. **PEO_2_BM_22**

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

3. **PEO_3_BM_22**

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

MAPPING OF PEOs

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

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

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

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

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

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

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

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

List of the PLOs

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

1. **PLO 01: Engineering Knowledge**
   Ability to apply knowledge of mathematics, science and engineering fundamentals and an engineering specialization to the solution of complex engineering problems
2. **PLO 02: Problem Analysis**
   Ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences
3. **PLO 03: Design/Development of Solutions**
   Ability to design solutions for complex engineering problems and design systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations
4. **PLO 04: Investigation**
   Ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions
5. **PLO 05: Modern Tool Usage**
   Ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations
6. **PLO 06: The Engineer and Society**
   Ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.

7. **PLO 07: Environment and Sustainability**

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

8. **PLO 08: Ethics**

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

9. **PLO 09: Individual and Team Work**

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

10. **PLO 10: Communication**

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

11. **PLO 11: Project Management**

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

12. **PLO 12: Lifelong Learning**

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

MAPPING OF PLOs

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

Table C1: Mapping of PLOs with the PEOs

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

Scheme of Studies (B.E. Biomedical Engineering) for 22BME Batch

1st Semester 1st Year					
S. No.	**Code**	**Course Title**	**Theory**	**Lab**	**Combined**
1	MTH121	Applied Physics	3	1	4
2	CS123	Introduction to Computers	2	1	3
3	MTH106	Functional English	3	0	3
4	MTH122	Basic Mathematics	3	0	3
	MTH123	Basic Biology	3	0	3
5	BM101	Introduction to Biomedical Engineering	2	0	2
6	MTH105	Islamic Studies	2	0	2
Total Semester Credit Hours			**15**	**2**	**17**
2nd Semester 1st Year					
S. No.	**Code**	**Course Title**	**Theory**	**Lab**	**Combined**
7	ES104	Basic Electronics	3	1	4
8	MTH124	Calculus & Analytical Geometry	3	0	3
9	BM102	Physiology I	2	1	3
10	ES105	Circuit Analysis	3	1	4
11	MTH107	Communication Skills	2	0	2
12	ES210	Computer Aided Engineering Design	0	1	1
Total Semester Credit Hours			**13**	**4**	**17**
1st Semester 2nd Year					
S. No.	**Code**	**Course Title**	**Theory**	**Lab**	**Combined**
13	MTH103	Differential Equations and Fourier Series	3	0	3
14	BM201	Physiology II	2	1	3
15	ES208	Digital Logic Design	3	1	4
16	MTH104	Pakistan Studies	2	0	2
17	BM202	Human Anatomy	2	1	3
18	MTH221	Object Oriented Programming	2	1	3
Total Semester Credit Hours			**14**	**4**	**18**
2nd Semester 2nd Year					
S. No.	**Code**	**Course Title**	**Theory**	**Lab**	**Combined**
19	BM203	Biomedical Electronics	3	1	4
20	BM204	Biochemistry	2	1	3
21	MTH201	Complex Variables and Transforms	3	0	3
22	ES220	Microprocessor & Interfacing	2	1	3
23	ES221	Signals & Systems	3	1	4
Total Semester Credit Hours			**13**	**4**	**17**

1st Semester 3rd Year					
S. No.	**Code**	**Course Title**	**Theory**	**Lab**	**Combined**
24	BM301	Biomedical Instrumentation I	3	1	4
25	MTH320	Probability & Statistics	3	0	3
26	MTH321	Numerical Methods	3	0	3
27	BM302	Biomechanics	3	1	4
28	BM303	Biomedical Signal Processing	3	1	4
Total Semester Credit Hours			**15**	**3**	**18**
2nd Semester 3rd Year					
S. No.	**Code**	**Course Title**	**Theory**	**Lab**	**Combined**
29	BM304	Biomedical Instrumentation II	3	1	4
30	BM305	Medical Device Quality System and Standards	3	0	3
31	BM306	Biomedical Control Systems	3	1	4
32	CS321	Modelling & Simulation	2	1	3
33	BM307	Biomaterials	3	1	4
Total Semester Credit Hours			**14**	**4**	**18**
1st Semester Final Year					
S. No.	**Code**	**Course Title**	**Theory**	**Lab**	**Combined**
34	MTH421	Engineering Management	2	0	2
35	BM401	Medical Imaging	2	1	3
36	ES410	Power Electronics	3	1	4
37	BM402	Rehabilitation Engineering	2	1	3
38	MTH422	Technical Report Writing	3	0	3
39	BM411	Biomedical Engineering Project (Phase I)	0	3	3
Total Semester Credit Hours			**12**	**6**	**18**
2nd Semester Final Year					
S. No.	**Code**	**Course Title**	**Theory**	**Lab**	**Combined**
40	BM403	Nano Biotechnology	3	0	3
41	MTH423	Professional Practices & Ethics	3	0	3
42	BM404	Medical Image Processing	2	1	3
43	MTH424	Entrepreneurship	3	0	3
44	BM412	Biomedical Engineering Project (Phase II)	0	3	3
Total Semester Credit Hours			**11**	**4**	**15**
Total Credit Hours			**107**	**31**	**138**

Mapping of Curriculum to PLOs

B.E. Biomedical Engineering Courses		Program Learning Outcomes											
Course Code	Course Title	PLO 01	PLO 02	PLO 03	PLO 04	PLO 05	PLO 06	PLO 07	PLO 08	PLO 09	PLO 10	PLO 11	PLO 12
1st Semester 1st Year													
MTH121	Applied Physics	C2, P3	C3										
CS123	Introduction to Computers	C2, P3				C3							
MTH106	Functional English										C3		
MTH122	Basic Mathematics	C1, C3											
MTH123	Basic Biology	C2											
BM101	Introduction to Biomedical Engineering	C2											
MTH105	Islamic Studies								C3				C3
2nd Semester 1st Year													
ES104	Basic Electronics	C2	C4		P3								
MTH124	Calculus & Analytical Geometry	C1	C2, C3										
BM102	Physiology I	C2, C3, P1, P2											
ES105	Circuit Analysis	C2	C2, P4										
MTH107	Communication Skills									A2	C3	A3	
ES210	Computer Aided Engineering Design	P2				P3				A3			
1st Semester 2nd Year													
MTH103	Differential Equations and Fourier Series		C1	C5	C3								
BM201	Physiology II	C2, C4, P1											
ES208	Digital Logic Design	C2	C3		C4	P3				A3			
MTH104	Pakistan Studies						C2						C2
BM202	Human Anatomy	C2, C4, P3											
MTH221	Object Oriented Programming		C2	C3	C3	P3							
2nd Semester 2nd Year													
BM203	Biomedical Electronics	C2	C4		P3								
BM204	Biochemistry	C2	C2		P3								
MTH201	Complex Variables and Transforms				C1, C2, C3								
ES220	Microprocessor & Interfacing	C2	C4			P3							
ES221	Signals & Systems	C2	C2, C3			P3							
1st Semester 3rd Year													
BM301	Biomedical Instrumentation I	C2		P3						A4		C5	
MTH320	Probability & Statistics	C1	C3										
MTH321	Numerical Methods	C3	C4		C3								
BM302	Biomechanics	C2	P2				C3						
BM303	Biomedical Signal Processing	C2		C6	C4, P3								

Course Code	Course Title	PLO 01	PLO 02	PLO 03	PLO 04	PLO 05	PLO 06	PLO 07	PLO 08	PLO 09	PLO 10	PLO 11	PLO 12
2nd Semester 3rd Year													
BM304	Biomedical Instrumentation II	C2		C2			P2	A4					
BM305	Medical Device Quality System and Standards	C2					C2						C2
BM306	Biomedical Control Systems	C2			C4	P3							
CS321	Modelling & Simulation	C2			C4			A4				P2	
BM307	Biomaterials	C2		C2		P1		C3					
1st Semester Final Year													
MTH421	Engineering Management			C6	C5					C2		C2	
BM401	Medical Imaging	C2	C3		P3		A4						
ES410	Power Electronics	C2	C4		P3								
BM402	Rehabilitation Engineering	C2, P1	P3										
MTH422	Technical Report Writing	C6									C3		
BM411	Final Year Design Project-I	C5	C4	P3	P3	P3	A4	A4	A4	A4	A4	C6	
2nd Semester Final Year													
BM403	Nano Biotechnology	C2											C4
MTH423	Professional Practices & Ethics								C2, C3, A3				
BM404	Medical Image Processing	C2	C4			P3							
MTH424	Entrepreneurship								A3			A3	C2
BM412	Final Year Design Project-II		C5	C6	P3		A4	A4	A4	A4	A4	P3	A4
	PLO Frequency	**34**	**20**	**9**	**16**	**10**	**7**	**5**	**5**	**7**	**5**	**7**	**6**

COURSE WISE FRAME WORK FOR B.E. BIOMEDICAL ENGINEERING

Course No.	Course Title	Knowledge Area	Sub Area	Credit Hours (Theory + Practical)		Contact Hours (Theory + Practical)	Total Credit Hours	Marks Theory	Marks Practical
1st Semester 1st Year									
MTH121	Applied Physics	Natural Sciences	Physics	3	1	3+3	4	**100**	**50**
CS123	Introduction to Computers	Computing	Fundamentals	2	1	2+3	3	**50**	**50**
MTH106	Functional English	Humanities	English	3	0	3+0	3	**100**	**00**
MTH122/ MTH123	Basic Mathematics / Basic Biology	Natural Sciences		3	0	3+0	3	**100**	**00**
BM101	Introduction to Biomedical Engineering	Engineering (Biomedical) Foundation (Core)		2	0	2+0	2	**50**	**00**
MTH105	Islamic Studies/ Ethics	Humanities	Culture	2	0	2+0	2	**50**	**00**
2nd Semester 1st Year									
ES104	Basic Electronics	Engineering (Biomedical) Foundation (Core)		3	1	3+3	4	**100**	**50**
MTH124	Calculus & Analytical Geometry	Natural Sciences	Mathematics	3	0	3+0	3	**100**	**00**
BM102	Physiology I	Engineering (Biomedical) Foundation (Core)		2	1	2+3	3	**50**	**50**
ES105	Circuit Analysis	Engineering (Biomedical) Foundation (Core)		3	1	3+3	4	**100**	**50**
MTH107	Communicati on Skills	Humanities	English	2	0	2+0	2	**50**	**00**
ES210	Computer Aided Engineering Design	Engineering (Biomedical) Foundation (Core)		0	1	0+3	1	**00**	**50**
1st Semester 2nd Year									
MTH103	Differential Equations and Fourier Series	Natural Sciences	Mathematics	3	0	3+0	3	**100**	**00**
BM201	Physiology II	Engineering (Biomedical) Foundation (Core)		2	1	2+3	3	**50**	**50**
ES208	Digital Logic Design	Engineering (Biomedical) Foundation (Core)		3	1	3+3	4	**100**	**50**
MTH104	Pakistan Studies	Humanities	Culture	2	0	2+0	2	**50**	**00**
BM202	Human Anatomy	Engineering (Biomedical) Foundation (Core)		2	1	2+3	3	**50**	**50**
MTH221	Object Oriented Programming	Computing	Fundamentals	2	1	2+0	3	**50**	**50**
2nd Semester 2nd Year									
BM203	Biomedical Electronics	Major Based Core (Breadth)		3	1	3+3	4	**100**	**50**
BM204	Biochemistry	Natural Sciences		2	1	2+3	3	**50**	**50**

MTH201	Complex Variables and Transforms	Natural Sciences	Core	3	0	3+0	3	**100**	**00**
ES220	Microprocessor & Interfacing	Major Based Core (Breadth)		2	1	2+3	3	**50**	**50**
ES221	Signals & Systems	Major Based Core (Breadth)		3	1	3+3	4	**100**	**50**
1st Semester 3rd Year									
BM301	Biomedical Instrumentation I	Major Based Core (Breadth)		3	1	3+3	4	**100**	**50**
MTH320	Probability & Statistics	Major Based Core (Breadth)		3	0	3+0	3	**100**	**00**
MTH321	Numerical Methods	Natural Sciences	Mathematics	3	0	3+0	3	**100**	**00**
BM302	Biomechanics	Major Based Core (depth)		3	1	3+3	4	**100**	**50**
BM303	Biomedical Signal Processing	Major Based Core (Breadth)		3	1	3+3	4	**100**	**50**
2nd Semester 3rd Year									
BM304	Biomedical Instrumentation II	Major Based Core (depth)		3	1	3+3	4	**100**	**50**
BM305	Medical Device Quality System and Standards	Interdisciplinary Engineering Breadth (Electives)		3	0	3+0	3	**100**	**00**
BM306	Biomedical Control Systems	Major Based Core (depth)		3	1	3+3	4	**100**	**50**
CS321	Modelling & Simulation	Computing	Design	2	1	2+3	3	**50**	**50**
BM307	Biomaterials	Interdisciplinary Engineering Breadth (Electives)		3	1	3+3	4	**100**	**50**
1st Semester Final Year									
MTH421	Engineering Management	Management Sciences		2	0	2+0	2	**50**	**00**
BM401	Medical Imaging	Interdisciplinary Engineering Breadth (Electives)		2	1	2+3	3	**50**	**50**
ES410	Power Electronics	Interdisciplinary Engineering Breadth (Electives)		3	1	3+3	4	**100**	**50**
BM402	Rehabilitation Engineering	Interdisciplinary Engineering Breadth (Electives)		2	1	2+3	3	**50**	**50**
MTH422	Technical Report Writing	Humanities	English	3	0	3+0	3	**100**	**00**
BM411	Biomedical Engineering Project (Phase I)	Senior Design Project		0	3	0+9	3	**00**	**100**
2nd Semester Final Year									
BM403	Nano Biotechnology	Interdisciplinary Engineering Breadth (Electives)		3	0	3+0	3	**100**	**00**
MTH423	Professional Practices & Ethics	Humanities	Social Sciences	3	0	3+0	3	**100**	**00**

BM404	Medical Image Processing	Interdisciplinary Engineering Breadth (Electives)		2	1	2+3	3	**50**	**50**
MTH424	Entrepreneurship	Management Sciences		3	0	3+0	3	**100**	**00**
BM412	Biomedical Engineering Project (Phase II)	Senior Design Project		0	3	0+9	3	**00**	**100**
			Total	**107**	**31**		**138**		

FRAME WORK FOR B.E. BIOMEDICAL ENGINEERING

National Qualifications Framework - Curriculum Design

Domain	Knowledge Area	PEC-HEC Recommended		Institute's Program Breakup	
		Total Credits	Overall %	Total Credits	Overall %
Non-Engineering	Humanities	As per discipline specific NCRC guidelines	25-35%	15	10.9
	Management Sciences			05	3.6
	Natural Sciences			22	15.94
	Total (Non-Engineering Credits /Total Credits)			42/138	30.43%
Engineering	Computing	As per discipline specific NCRC guidelines	65-75%	09	6.5
	Engineering Foundation			24	17.39
	Major Based Core (Breadth)			22	15.94
	Major Based Core (depth)			12	8.7
	Inter-Disciplinary Engineering Breadth (Electives)			23	16.67
	Senior Design Project			06	4.35
	Industrial Training (Summer)			0	0
	Total (Engineering Credits /Total Credits)			96/138	69.56%
	Over all Total			138	100%

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		

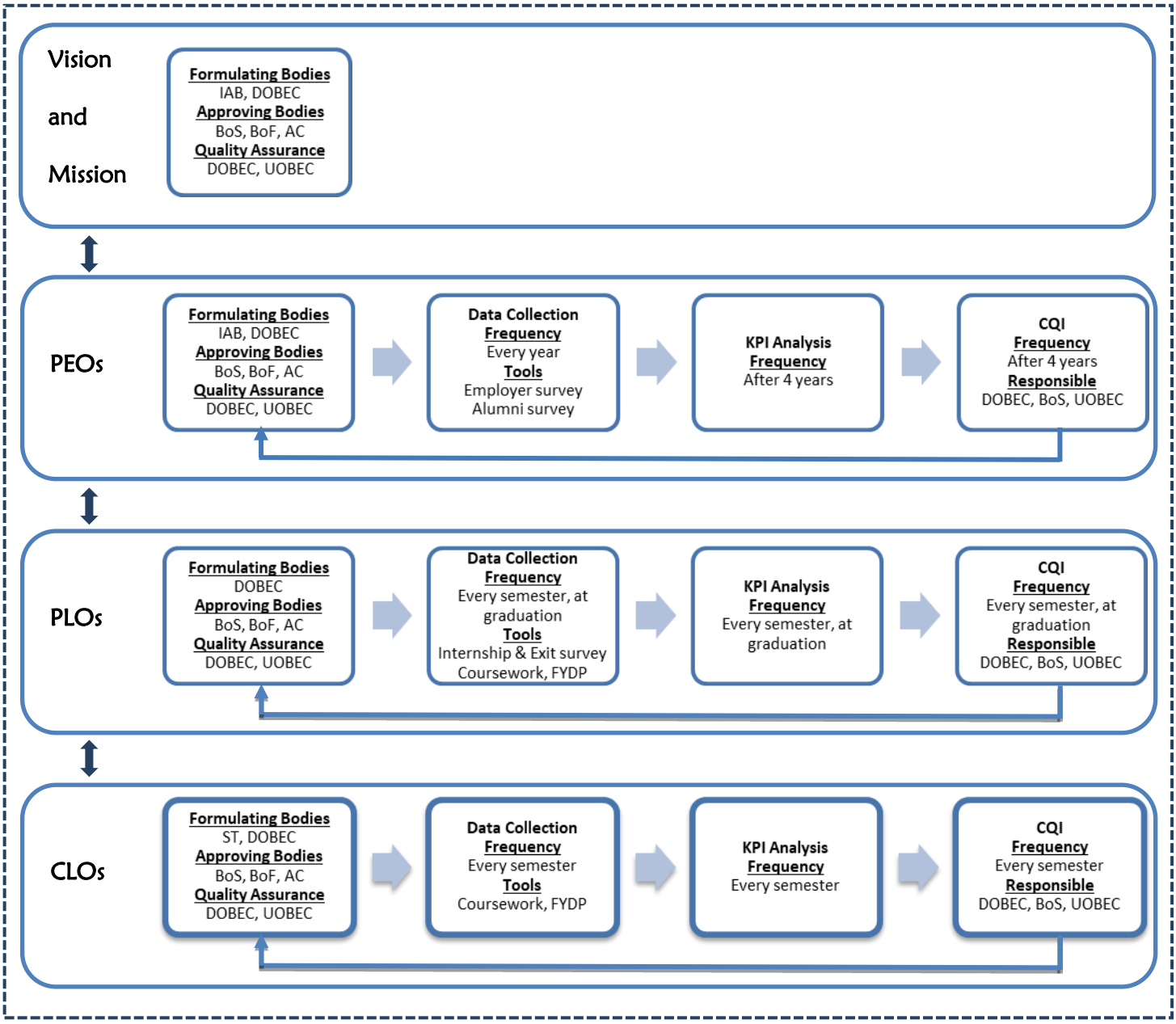
Continuous Quality Improvement (CQI)

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 2022

DETAILS OF COURSES
FOR BACHELOR IN BIOMEDICAL ENGINEERING

MTH101-Applied Physics

Contact Hours:
Theory =45
Practical = 45
Total = 90

Credit Hours:
Theory = 3.0
Practical = 1.0
Total = 4.0

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

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

Course Outline:

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

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

3. Heat and Thermodynamics
a. Heat, Temperature, and Theories of heat
b. Adiabatic and isothermal processes

c. The four laws of thermodynamics
d. Thermodynamic functions
e. Efficiency of Heat Engines
f. Carnot's Cycle
g. Entropy
h. Reversible Process and cycles
i. Thermodynamic equilibrium
j. Introduction to Heat transfer Mechanisms.

4. Optics

a. Waves and Oscillations
b. Simple Harmonic Motion
c. types of wave motion
d. Optics of light
e. Interference
f. Diffraction
g. Polarization
h. Double refraction
i. Dispersion
j. Types and uses of Deviation Lasers

5. Electricity and Magnetism

a. Electric charges
b. Electric field
c. Electric potential
d. Coulomb 'slaw
e. Gauss 'slaw
f. Capacitors and dielectrics
g. Electric current
h. Ohm's Law
i. Magnetic properties of matter
j. Magnetic field
k. Magnetic force concurrent
l. Ampere's law, Faraday's law, and Lenz 'slaw

6. Sound

a. Hearing and Echolocation
b. Ultrasound

Practical Outline:

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

Suggested Teaching Methodology:

- Lecturing
- Written Assignments

Suggested Assessment:

- **Theory (100%)**

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

- **Laboratory (100%)**

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

Text and Reference Books:

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

CS123-Introduction to Computers

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 components of Computer such as CPU, memory, peripheral devices, storage media and device, data organization, files storage	Cognitive	2	1
2.	**Interpret** software and hardware peripherals	Cognitive	3	5
4.	**Perform** installation of hardware and software systems	Psychomotor	3	1

Course Outline:

1. Introduction
a. Applications of Computers
b. Classification of Computers
c. Advantages and Disadvantages of Computers.
d. Basic Components of a Computing Machine.
e. Input and Output Devices
f. Mass Storage Devices
g. Ports, Buses and Expansion slots.
h. Computer Networking Environment

2. Data Storage
a. Data organization.
b. Data representation in Computers.
c. Physical and Logical Storage.
d. Magnetic Storage Devices viz. RAM, ROM, Secondary Storage, Cache.
e. Optical Storage Devices.

3. Data Processing
a. Data Structures.
b. Flowcharts.
c. Process Flow Diagrams

4. System and Application Programming
a. Basics of Operating Systems.
b. Desktop and Network Operating Systems, Application software's.

5. Computer Programming

a. Introduction to High Level and Low Level Programming Languages.
b. Process of Compilation and Interpretation.
c. Data Types and Declaration.
d. Header file and Linkage.
e. Preprocessor Directives.
f. Variables and Constants.
g. Basic library functions.
h. Input and Output Statements.
i. Termination, Remarks.
j. Control structures
k. Repetition and loops.
l. Arrays and String Operations
m. Data Filling
n. Using Graphics Libraries in Python/C++.

6. Defining an Engineering Problem

a. Transforming Data in to Information.
b. Using Computers to Solve an Engineering Problem.

7. Semester Project- Group Activity

Practical:

Perform installation of hardware and software systems such as Windows 8/10, DOS, Python/C++, Preparing your PC for Python/C++, Shell and IDLE in Python and/or C++IDE, Making small programs, do compilation, execution and debugging of programs, Implementation of simple control structures using Loops, Implementation of function using user input and presenting output, arrays, functions in Python/C++.

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. Brian Williams and Stacey Sawyer, Using Information Technology, Latest Edition, McGraw-Hill, ISBN:0072260718

2. William Stallings, Computer Organization and Architecture: Designing for Performance, Latest Edition, Prentice Hall, latest edition.
3. Allen Downey; Think Python: How to Think Like a Computer Scientist; Green Tea Press Needham, Massachusetts.
4. David Beazley and Brian K. Jones, “PYTHON Cookbook”; O'Reilly Atlas.

MTH106-Functional English

Contact Hours:
Theory = 45
Practical= 00
Total= 45

Credit Hours:
Theory = 3.0
Practical = 0.0
Total = 3.0

COURSE LEARNING OUTCOMES:

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

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

Course Outline:

Basics of Grammar

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

Comprehension

Answers to questions on a given text

Discussion

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

Listening

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

Translation skills

Urdu to English

Paragraph writing

Topics to be chosen at the discretion of the teacher

Presentation skills

Introduction
Note: Extensive reading is required for vocabulary building

Suggested Assessment:

- **Theory (100%)**

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

Recommended books:

1. Functional English
a) Grammar
1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506
b) Writing
1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.
c) Reading/Comprehension
1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. .
d) Speaking

MTH122-Basic Mathematics

Contact Hours:
Theory = 45
Practical= 00
Total= 45

Credit Hours:
Theory = 3.0
Practical = 0.0
Total = 3.0

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

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

Course Outline:

1. Algebra
a. Complex Numbers
b. Properties of complex numbers
c. Conjugates and modulus
d. Geometrical representation of complex numbers a+ib.

2. Quadratic Equations
a. Roots of a quadratic equation (real, distinct, equal and imaginary roots)
b. Formation of quadratic equation when the roots are given

3. Cube Root of Unity
a. Properties of cube root of unity; ω, ω^2, $1+\omega+\omega^2=0$, etc.

4. Matrices
a. Properties, sum, difference and multiplication of matrices
b. Cramer's rule
c. Solution of linear equations of three unknowns

5. Determinants
a. Properties: addition, subtraction and multiplication of determinants
b. Sequence and series
c. Arithmetic progression
d. Standard forms of an A.P.
e. Arithmetic means
f. Geometric progression
g. Standard forms of a G.P.,
h. Sum of Infinite geometric series

i. Geometric means
j. Harmonic progression
k. Harmonic means
l. Relation between H.M., A.M. and G.M.

6. Binomial Expansion

a. Expansion of type $(a+b)^n$ for positive integer of'n'
b. Use of the general 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 $\chi\sin\chi$, χe^{χ} and $\log\chi$ etc.
e. Substitution method

14. Coordinate Geometry

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

Suggested Assessment:

- **Theory (100%)**

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

Text and Reference Books:

1. FSC Maths Part I/II

MTH123-Basic Biology

Contact Hours:
Theory = 45
Practical= 00
Total= 45

Credit Hours:
Theory = 3.0
Practical = 0.0
Total = 3.0

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

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

Course Outline:

1. Cell Structure and Function
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

BM101-Introduction to Biomedical Engineering

Contact Hours:
Theory = 30
Practical= 00
Total= 30

Credit Hours:
Theory = 2.0
Practical = 0.0
Total = 2.0

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

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

Course Outline:

1. Biomedical Engineering
   a. What is biomedical engineering
   b. Branches of biomedical engineering
   c. Role of biomedical engineer

2. Devices used in Biomedical Engineering
   a. Biomedical instrumentation fundamental
   b. Critical care devices used in biomedical engineering
   c. Radiological instrumentation.
   d. Diagnostic biomedical devices
   e. Therapeutic Biomedical devices

3. Applications of Biomedical Engineering
   a. Rehabilitation Engineering
   b. Physiological modeling and simulation
   c. Biomedical signal processing
   d. Clinical Engineering
   e. Biomaterials
   f. Biomechanics
   g. Tissue Engineering and regenerative medicine
   h. Neural engineering
   i. Medical Image Processing

Suggested Teaching Methodology:

- Lecturing

- Written Assignments
- Guest Speaker
- Report Writing

Suggested Assessment:

- **Theory (100%)**

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

Text and Reference books:

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

MTH105-Islamic Studies/Ethics

Contact Hours:
Theory = 30
Practical= 00
Total= 30

Credit Hours:
Theory = 2.0
Practical = 0.0
Total = 2.0

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

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

Course Outline:

1. Introduction to Quranic Studies
   a. Basic Concepts of Quran
   b. History of Quran
   c. Uloom-ul-Quran

2. Study of Selected Text of Holly Quran
   a. Verses of Surah Al-Baqra Related to Faith (VerseNo-284-286)
   b. Verses of Surah Al-Hujrat Related to Adab Al-Nabi (VerseNo-1-18)
   c. Verses of Surah Al-Mumanoon Related to Characteristics of faithful (VerseNo-1-11)
   d. Verses of Surah al-Furqan Related to Social Ethics (VerseNo.63-77)
   e. Verses of Surah Al-Inam Related to Ihkam (VerseNo-152-154)

3. Study of Selected Text of Holy Quran
   a. Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
   b. Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
   c. Verses of Surah Al-Saf Related to Tafakar, Tadabar (VerseNo-1,14)

4. Seerat of Holy Prophet (S.A.W)
   a. Life of Muhammad Bin Abdullah (Before Prophet Hood)
   b. Life of Holy Prophet (S.A.W) in Makkah
   c. Important Lessons Derived from the life of Holy Prophet in Makkah

5. Seerat of Holy Prophet (S.A.W)
   a. Life of Holy Prophet (S.A.W) in Madina
   b. Important Events of Life Holy Prophet in Madina
   c. Important Lessons Derived from the life of Holy Prophet inMadina

6. Introduction to Sunnah

a. Basic Concepts of Hadith
b. History of Hadith
c. Kinds of Hadith
d. Uloom–ul-Hadith
e. Sunnah & Hadith
f. Legal Position of Sunnah

7. Selected Study from Text of Hadith:

8. Islamic Law &Jurisprudence

a. Basic Concepts of Islamic Law &Jurisprudence
b. History & Importance of Islamic Law &Jurisprudence
c. Sources of Islamic Law &Jurisprudence
d. Nature of Differences in Islamic Law
e. Islam and Sectarianism

9. Islamic Culture &Civilization

a. Basic Concepts of Islamic Culture &Civilization
b. Historical Development of Islamic Culture &Civilization
c. Characteristics of Islamic Culture &Civilization
d. Islamic Culture & Civilization and Contemporary Issues

10. Islam &Science

a. Basic Concepts of Islam &Science
b. Contributions of Muslims in the Development of Science
c. Quran &Science

11. Islamic Economic System

a. Basic Concepts of Islamic Economic System
b. Means of Distribution of wealth in Islamic Economics
c. Islamic Concept forbid
d. Islamic Ways of Trade &Commerce

12. Political System of Islam

a. Basic Concepts of Islamic Political System
b. Islamic Concept of Sovereignty
c. Basic Institutions of Govt. in Islam

13. Islamic History

a. Period of Khlaft-e-Rashida
b. Period of Ummayyads
c. Period of Abbasids

14. Social System of Islam

a. Basic concepts of Social System of Islam
b. Elements of Family
c. Ethical values of Islam

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

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

Text and Reference Books:

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

ES104-Basic 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 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.

MTH124-Calculus & Analytical Geometry

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.	**Identify** functions and define real and complex numbers	Cognitive	1	1
2.	**Apply** differential, integral calculus, and analytical geometry to engineering problems of change, optimization, and areas	Cognitive	3	2
3.	**Discuss** the behavior of sequence and series	Cognitive	2	2

Course Outline:

1. Limits and Continuity

a. Introduction to Limits
b. Rates of Change and Limits
c. One-Sided Limits, Infinite Limits
d. Continuity, Continuity at a Point, Continuity on an interval

2. Differentiation

a. Definition and Examples
b. Relation Between Differentiability and Continuity
c. Derivative as slope, as rate of change (graphical representation).
d. The Chain Rule
e. Applications of Ordinary Derivatives

3. Integration

a. Indefinite Integrals
b. Different Techniques for Integration
c. Definite Integrals
d. Riemann Sum, Fundamental Theorem of Calculus
e. Area Under the Graph of a Nonnegative Function
f. Improper Integrals

4. Transcendental Functions

a. Inverse functions
b. Logarithmic and Exponential Functions
c. Inverse Trigonometric Functions
d. Hyperbolic Functions and Inverse Hyperbolic Functions
e. More Techniques of Integration

5. Analytical Geometry

a. Three Dimensional Geometry
b. Vectors in Spaces
c. Vector Calculus
d. Directional Derivatives
e. Divergence, Curl of a Vector Field
f. Multivariable Functions
g. Partial Derivatives

6. Analytical Geometry

a. Conic Sections
b. Parameterizations of Plane Curves
c. Vectors in Plane, Vectors in space
d. Dot Products, Cross Products
e. Lines and Planes in Space
f. Spherical, Polar and Cylindrical Coordinates.
g. Vector-Valued Functions and Space Curves
h. Arc-Length and Tangent Vector
i. Curvature, Torsion and TNB Frame
j. Fubini's Theorem for Calculating Double Integrals
k. Areas Moments and Centers of Mass
l. Triple Integrals, Volume of a Region in Space

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. Advanced Engineering Mathematics, by Erwin Kreyszig, 8th Edition
2. Calculus And Analytical Geometry, Schaum's Series

BM102- Physiology I

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.	**Understand** the fundamental concepts and methods of a life or physical science.	Cognitive	2	1
2.	**Apply** the systematic technique to explore natural phenomena, including hypothesis development, observation, experimentation, measurement, data analysis, and data presentation.	Cognitive	3	1
3.	**Recognize** the physiological principles of cells and tissue, and muscular, skeletal, immune, and nervous systems	Psychomotor	1	1
4.	**Use** the tools of a scientific discipline to carry out collaborative laboratory Investigations.	Psychomotor	3	1

Course Outline:

1. Introduction
- **a.** The Cell and General Physiology
- **b.** Functional organization of human body and control of the internal environment
- **c.** Cell and its function, protein synthesis and cell reproduction
- **d.** Metabolism of carbohydrates and formation of ATP
- **e.** Lipid and Protein Metabolism, transport through Cell membrane

2. Human physiology from a system's viewpoint
- **a.** Quantitative issues at the organ and whole-body levels of Cardiovascular
- **b.** Respiratory
- **c.** Renal
- **d.** Digestive systems

3. Nerve and Muscle
- **a.** Membrane potential
- **b.** Action potential
- **c.** Excitation and Rhythmicity
- **d.** Contraction of Skeletal and cardiac muscles,sliding filament Mechanism, Heart as

a pump

4. **Sensory Systems**
   - **a.** Sensory Receptors
   - **b.** Classification and basic mechanism of action

5. **Somatic Sensations**
   - **a.** Mechano receptive sensations, pain, thermal and visceral pain, headache

6. **Special Senses**
   - **a.** Eye, receptor function of the retina, Neurophysiology of Vision, the Chemical Sense-taste and smell

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. 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

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

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

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:
- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

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

- **Laboratory (100%)**

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

Text book & Reference Books:

1. Engineering Circuit Analysis by William Hayt, 8th Edition, 2012. ISBN: 978-0073263182
2. Fundamentals of Electric Circuits by Charles K.Alexander, Matthew N. O. Sadiku. 5th Edition, 2008.ISBN978-0077263195

MTH107- Communication Skills

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.	**Draft** varied texts including formal letters, CV, cover letter for jobs, and Short technical reports using mechanisms of academic writing integrated with paraphrasing and summarizing techniques.	Cognitive	3	10
2.	**Apply** the best communication skills for the successful completion of project during its entire life cycle.	Affective	3	11
3.	**Acquire** effective verbal and written skills to communicate effectively in a team environment.	Affective	2	9

Course Outline:

1. **Essay Writing and 7C's of Communication**
   a. Kinds of Essays
   b. Ways to Develop a Proper Beginning, Middle and Ending of Essay
   c. 7C's of Communication
2. **Use of Library and Internet Resources**
   a. Defining "The Library" and "The Internet"
   b. Researching in the library
   c. Researching on the internet
3. **Correction of Sentences and Question Tags**
   a. General rules of correction
   b. Examples
   c. Uses and Forms of Question Tags
   d. Procedure adding a Question Tag
4. **Précis Writing**
   a. Rules for Précis Writing
   b. Examples
5. **Verbal Communication: Strategies and Activities**
   a. Group Discussions
   b. Brainstorming
   c. Interviewing

d. Creating newscast

6. Paraphrasing

a. Introduction
b. Uses of Paraphrasing
c. Characteristics of a good Paraphrase
d. Method of procedure
e. Specimens

7. Report Writing

a. Importance of Reports;
b. Guidelines for Informal Report Writing;
c. Informal Report Writing Practice sessions

8. Curricula Vitae :

a. Introduction
b. General Format
c. Types of CV'
d. Template for CV
e. Optional Features
f. Sample CV

9. Minutes of Meeting

a. Introduction
b. Meeting minutes Format
c. Common Problems while taking Minutes of a Meeting
d. Solution of Problems
e. Sample Minutes of a Meeting

10. Writing Memorandum

a. Introduction
b. Audience and Purpose
c. Format
d. Sample Memo

11. Resume Writing

a. What is Resume
b. Kinds of Resume
c. Role of a Resume

12. Job Application Materials

a. Job Application Letter, Acceptance, Follow-up, and Recommendation Letters
b. Examples and Practice Sessions
c. Planning the Resume and Letter

13. Presentations Skills

a. Individual & Group Presentation
b. Teaching Presentation as kill
c. Project Work on Power Point Presentations

Suggested Teaching Methodology:

- Lecturing

- Presentations
- 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. Exploring The World Of English, Sadat Ali Shah
2. High School English Grammar & Composition P. C. Wren & H.Martin
3. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 2. Third edition. Oxford University Press 1986.
4. Writing. Intermediate by Marie-Chrisitine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression, latest edition.
5. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).
6. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression, latest edition.
7. Reading and Study Skills by John Langan
8. Study Skills by Riachard Yorky.

ES210- Computer Aided Engineering Design

Contact Hours:
Theory = 00
Practical= 45
Total= 45

Credit Hours:
Theory = 0.0
Practical = 1.0
Total = 1.0

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

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

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

Suggested Teaching Methodology:
- Lecturing
- Lab tasks
- Report Writing

Suggested Assessment:

- **Laboratory (100%)**

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

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

MTH103- Differential Equations and Fourier Series

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.	**Discuss** Formation of Differential equation and first and higher order linear differential	Cognitive	1	2
2.	**Evaluate** second order partial differential equations	Cognitive	5	3
3.	**Apply** Fourier series and Fourier transform of various functions	Cognitive	3	4

Course Contents

Differential Equation of First Order

Differential equation and their classification, Formation of differential equations, Solution of differential equations, initial and boundary conditions. Methods of solution of differential equation of first order and first-degree : Separable equations, Homogeneous equations, Equations reducible to homogenous, Exact differential equations, integrating, factor, Linear equations, Bernoulli equations, Orthogonal trajectories in Cartesian and polar coordinates, Applications of first order differential equations : Equations solvable for p, For y and for x. Clairaut's equation.

Higher Order Linear Differential Equations

Homogenous linear equations of order n with constant coefficients, Auxiliary / characteristic equations. Solution of higher order differential equation according to the roots of auxiliary equation. (Real & distinct, Real & repeated & Complex). Non-homogenous linear equations, Working rules for finding particular integral, Cauchy-Euler equation, Method of variation of parameters of solving the differential equation, Applications of higher order linear differential equations.
Case studies: First and second order differential equations.

Introduction to partial differential equations:

Methods of separable variable, Laplace equation, Wave equation and one dimensional heat equation.

Infinite Series

Introduction to sequence and series. Harmonic series, Convergence and divergence of infinite series. Ration test, Root test, Raabe's test and integral test.

Fourier Series

Periodic function, Fourier coefficients, Fourier series of periodic functions with period 2 , Fourier series of functions with arbitrary period, Convergence of Fourier series. Fourier series of odd and even functions, Half range Fourier cosine and sine series.

Recommended Books

1. H.K. Dass. "Advance Engineering Mathematics" , latest edition.
2. Dr. B.S. Grawall. "Higher Engineering Mathematics", latest edition.
3. Dr. S.M Yousif, "Mathematical Methods", latest edition.

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%)

BM201- Physiology II

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.	**Demonstrate** the physiological principles of nervous, reproductive, endocrine and lymphatic systems through the scientific tools to carry out laboratory investigations.	Psychomotor	1	1

Course Outline:

1. Nervous System
a. Organization of Nervous System
b. Basic functions of synapses
c. Neuronal Mechanism and circuits for processing information

2. Motor Functions
a. Spinal cord and the cord reflexes
b. The cerebral cortex and intellectual functions of the Brain
c. Motor function of the Brainstem
d. Vestibular control of postural reflexes
e. Cerebrum and basal ganglia
f. Reticular

3. Somatic Sensations
a. Mechano receptive sensations
b. Pain
c. Thermal and visceral pain
d. Headache

4. Behavioral functions of the Brain

a. Limbic System
b. Role of the Hypothalamus
c. Control of the vegetative functions of the body
d. The Autonomic nervous system
e. The Adrenal Medulla
f. Electrical Activity from Brain

5. Endocrinology and Reproduction

a. Introduction to Endocrinology and the pituitary Hormones;
b. Hormonal functions in male and female

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. Text book of Medical Physiology by Guyton and Hall (13thEdition).
2. Essential of Medical Physiology by Jaypee (6thEdition).
3. William F, "Review of Medical Physiology".

ES208- Digital Logic Design

Contact Hours:
Theory = 45
Practical= 45
Total= 90

Credit Hours:
Theory = 3.0
Practical = 1.0
Total = 4.0

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

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

Course Outline:
Introductory digital concepts. Number Systems & Conversion.

- **Logic Gates**

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

- **Boolean Algebra and Boolean Operations**

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

- **Combinational Logic Circuits**

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

- **Flip Flops**

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

- **Digital Circuits**

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

- **Semiconductor Memory**

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

- **Introduction to Sequential Machines**

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

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

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

- **Laboratory (100%)**

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

Text and Reference Books:

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

MTH104- Pakistan Studies

Contact Hours:
Theory = 30
Practical= 00
Total= 30

Credit Hours:
Theory = 2.0
Practical = 0.0
Total = 2.0

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

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

Course Outline:

1. Historical Perspective

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.

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.

MTH221- 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.

BM203- Biomedical Electronics

Contact Hours:
Theory = 45
Practical= 45
Total= 90

Credit Hours:
Theory = 3.0
Practical = 1.0
Total = 4.0

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

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

Course Outline:

BJT:

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

Power Amplifier:

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

Operational Amplifier:

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

Filters:

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

Oscillators:

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

Introduction to BiCMOS:

Cascaded and cascaded configuration; application in biomedical.

Practical:

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

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

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

- **Laboratory (100%)**

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

Text and Reference Books:

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

BM204- Biochemistry

Contact Hours:
Theory =30
Practical=45
Total=75

Credit Hours:
Theory = 2.0
Practical = 1.0
Total = 3.0

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

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

Course outline:

1. Basic Concepts of Biochemistry:

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

2. Protein Synthesis through Gene Expression:

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

3. Bioenergetics:

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

4. Carbohydrate Metabolism:

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

5. Lipid Metabolism:

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

6. Nitrogen Metabolism:

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

Practical:

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

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)
Mid Semester (20%)
Final Semester (60%)

- **Laboratory (100%)**

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

Text and Reference Books:

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

MTH201- Complex Variable and Transforms

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.	**Identify** the complex number system, complex functions and integrals of complex functions	Cognitive	1	4
2.	**Explain** the concept of limit and differentiability of complex valued functions and the properties of various transforms	Cognitive	2	4
3.	**Apply** various transforms for solving problems in engineering sciences	Cognitive	3	4

Course Outline:

1. The complex number and complex variables

a. Complex differentiation and integration
b. Laplace Transformation and its applications
c. Series solution of the DEs
d. Complex number systems and Complex Variable theory
e. Introduction to complex number systems
f. Argands diagram, modulus and argument of a complex number
g. Polar form of a complex number
h. De Moivres theorem and its applications
i. Complex functions, analytical function, harmonic and conjugate harmonic functions
j. Cauchy-Remann equations (in Cartesian and polar coordinates).
k. Line integral
l. Greens theorem
m. Cauchy theorem
n. Cauchy's integral formula
o. Singularities, poles, residue and contour integration and application

2. Laplace Transforms

a. Laplace transforms of elementary functions
b. Properties of Laplace transform

c. Laplace transform of derivatives, integrals
d. Multiplication by t and division by properties
e. Periodic functions and their Laplace transforms
f. Inverse Laplace transforms and their properties
g. Convolution theorem
h. Inverse Laplace transforms by integral and partial fraction methods
i. Heaviside expansion formula
j. Solution of ordinary differential equations by Laplace transform
k. Applications of Laplace transformation on various fields of engineering

3. Series Solution of Differential Equations

a. Introduction
b. Validity of series solution
c. Ordinary point, singular point
d. Forbeniu's method
e. Indicial equation
f. Bessel's differential equation, its solution of first kind and its recurrence formulae
g. Logendre' differential equation and its solution
h. Rodriguez formula

4. Fourier Transform

a. Fourier transform of simple functions
b. Magnitude and phase spectra
c. Fourier transform theorems
d. Inverse Fourier transform
e. Solution of differential equation using Fourier transform

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. Erwin Kreyszig, Advance Engineering Mathematics, latest edition.
2. Robert L. Borrelli and Courtney S. Coleman, Differential Equations: A Modeling Perspective, latest edition.
3. Dennis G. Zill and Warren S. Wright, Differential Equations with Boundary-Value

Problems, latest edition.

4. Eric W. Hansen, Fourier Transforms: Principles and Applications, latest edition.
5. J. F. James, A Student's Guide to Fourier Transforms: With Applications in Physics and Engineering, latest edition.
6. R. J. Beerends and H. G. terMorsche, Fourier and Laplace Transforms, latest edition.

ES220- Microprocessor & Interfacing

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** internal microprocessor architecture and operations	Cognitive	2	1
2.	**Illustrate** interfacing techniques of a microprocessor with memory and I/O devices	Cognitive	4	2
3.	**Under supervision,** simulate and probe Instruction Set Architecture of a representative microprocessor	Psychomotor	3	5

Course Outline:

1. Introduction to Microprocessor and Microcontroller
   a. Microprocessor and its Architecture
   b. Simplified CPU / Memory Organization
   c. Addressing modes / Instruction Set Summary
   d. I/O port, pin diagram and functions
   e. Data Bus, Address Bus and Control Bus

2. Using Assembly Language with C/C++
   a. Introduction to Assembly programming
   b. I/O Programming
   c. Arithmetic and Logical Operations
   d. Program Looping and Subroutine
   e. Serial Port Programming
   f. Interrupts Programming

3. Data Acquisition Systems
   a. Analog to digital converters and performance Parameters
   b. Designing of a Data Acquisition Systems
   c. Serial Communication
   d. Synchronous and Asynchronous Communication

4. Interfacing Microprocessor/Microcontroller
   a. Memory / Basic I/O interface

b. RAM / ROM interfacing
c. Keypad, Seven Segment / LED and LCD display
d. Serial and Parallel ADC
e. Sensor Interfacing
f. Relays and Opto-isolators interfacing
g. Stepper Motor Interfacing
h. DC motor interfacing and PWM

5. Defining an Engineering Problem

a. Introduction to embedded system chip boarded signing
b. Component selection
c. Troubleshooting and problem fixing

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. Barry B. Brey,The Intel Microprocessor,8th ed. 2009, ISBN-10:0135026458
2. Microprocessor Fundamentals, Graw Hill Co., latest edition.
3. Douglas. V. Hall, Microprocessor and Interfacing,
4. Programming and Hardware, Mc. Graw Hill Co., 1986
5. Scott Mackenzie, "The 8051 Microcontroller", Prentice Hall, latest edition.
6. Muhammad Ali Mazidi, PIC Microcontroller and Embedded Systems, Pearson's Prentice Hall, latest edition.

ES221- Signals and Systems

Contact Hours:
Theory = 45
Practical= 45
Total= 90

Credit Hours:
Theory = 3.0
Practical = 1.0
Total = 4.0

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

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

Course Outline:

1. Signal and System Characteristics and Models
   a. Concept of Continuous-Time and Discrete-Time Signals and Systems
   b. Basic Operations on Signals
   c. Signal and system classifications

2. Time-Domain Representation of Continuous-Time Signals
   a. Sinusoidal and Complex Exponential Signals
   b. Singularity Function Signals
   c. Signal Energy and Power

3. Time-Domain Analysis of Continuous-Time Systems
   a. System Impulse Response
   b. Continuous-Convolution Evaluation and Properties

4. Frequency-Domain Representation of Continuous and Discrete-Time Signals
   a. Spectra and Bandwidths of Continuous-& Discrete Time Signals
   b. Fourier Series Representation of Signals
   c. Amplitude and Phase Spectra of Periodic Signals
   d. The Fourier Transform and Spectra of Aperiodic Signals
   e. Properties of Fourier transform

5. Frequency-Domain Analysis of Continuous-Discrete Time Systems

a. System Frequency Response
b. Amplitude and Phase Responses

6. Analysis of Continuous-Time Systems Using the Laplace Transform

a. Laplace Transform Evaluations and Theorems
b. Evaluation of Inverse Laplace Transforms
c. System Transfer Function and stability

7. Continuous-Time Filters

a. Distortion-less Transmission
b. Ideal Filters
c. Approximation of Ideal Filters
d. Butterworth and Chebyshev Filter Design

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

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

- **Laboratory (100%)**

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

Text and Reference Books:

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

BM301- Biomedical Instrumentation I

Contact Hours:
Theory = 45
Practical= 45
Total= 90

Credit Hours:
Theory = 3.0
Practical = 1.0
Total = 4.0

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

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

Course Outline:

Types of Biosignals

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

Basic Sensors and Transducers

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

Medical Instrumentation

Introduction to (medical) instrumentation; accuracy; sensitivity; reproducibility;

biocompatibility; classification; measurement constraints; invasive and non-invasive techniques; design criteria.

Biopotentials and Measurements

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

Measurements and Reporting

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

Hazards and Safety

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

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

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

- **Laboratory (100%)**

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

Recommended Text and Reference Books:

1. Biomedical Instrumentation and Measures by Leslie Cromwell, latest edition.
2. Bio-instrumentation by John G. Webster, latest edition.
3. Medical Instrumentation: Application and Design by John G. Webster. , latest edition.

MTH320- Probability and Statistics

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** general understanding of probability and statistics	Cognitive	1	1
2.	**Apply** the concepts of statistics and probability on a data set	Cognitive	3	2

Course Outline:

1. Descriptive Biostatistics
a. Introduction to Biostatistics,
b. Measures of Central Tendency,
c. Measures of Dispersion,
d. Frequency Distribution,
e. Graphical Methods (scatter plot, histogram, bar chart, stem-leaf plot etc.)

2. Introduction to Probability
a. Multiplication and Addition Laws of Probability,
b. Conditional Probability,
c. Bayes' Rule and Screening Tests, Bayesian Inference

3. Discrete Probability Distributions
a. Expected value and Variance of a Discrete Random Variable,
b. Cumulative-Distribution Function of a Discrete Random Variable,
Permutations and Combinations,
c. Binomial Distribution,
d. Poisson Distribution

4. Continuous Probability Distributions
a. Normal Distribution,
b. Properties of the Standard Normal Distribution,
c. Normal Distribution Applications,
d. Estimation of the Mean and Variance of a Distribution

5. Sampling Distributions
a. Central Limit Theorem

6. Hypothesis Testing

a. Hypothesis Testing (z-test t-test (one and two sample),
b. chi-squared test),
c. Analysis of Variance (ANOVA) (one-way & two-way),
d. Regression analysis

7. Statistical Software

a. Make appropriate use of statistical software (STATA, SPSS, MS- EXCEL etc)

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%)

Texts and Reference Books:

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

MTH321- Numerical Methods

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** common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems in life sciences	Cognitive	3	1
2.	**Analyze** and evaluate the accuracy of common numerical methods.	Cognitive	4	2
3.	**Apply** numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations in life sciences	Cognitive	3	4

Course Outline:

Error Analysis

Error types; significant digits; numerical instability.

Linear Operators and Difference Equations

Functions of operators; difference operators and derivative operators; identities; linear homogenous and nonhomogenous difference equations.

Solution of Linear Equations

Numerical methods for finding the roots of linear equations (Gaussian Elimination, Gauss-Jordan, triangularization, Cholesky; Jacobian and Gauss-Seidel).

Non-Linear Equations and Solution Techniques

Nonlinear equations in biomedical engineering; finding the roots of an equation; convergence testing; finite difference methods; numerical integration; differential equation models; setting up an appropriate model; writing equations from a state diagram; stability analysis; stiff and non-stiff systems.

Interpolation and Curve Fitting

Linear; polynomial; and spline interpolation methods; least squares approximation; nonlinear curves.

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

BM302- Biomechanics

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** gross human movements using anatomical terminology and the basic concepts of mechanics to study human movement.	Cognitive	2	1
2.	**Assess** the consequences of changes in movement patterns and techniques on the human performance for daily life activities, clinical, and biomechanical research applications.	Cognitive	3	6
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. Visco elasticity, 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%)

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. Susan J. Hall, Basic Bio-Mechanics, latest edition.
2. Margareta Nordin, Victor H. Frankel, Basic Biomechanics of the Muscul o skeletal System
3. Nihat Özkaya, et al, Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation, latest edition.
4. David A. Winter, Biomechanics and Motor Control of Human Movement, latest edition.

BM303- Biomedical Signal Processing

Contact Hours:
Theory = 45
Practical= 45
Total= 90

Credit Hours:
Theory = 3.0
Practical = 1.0
Total = 4.0

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

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

Course Outline:

Overview of Discrete-time Signals and Systems

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

Linear Constant Coefficient Difference Equations

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

Discrete Time Fourier Series

Representation of discrete time periodic signals, signal analysis using discrete time Fourier series, properties of discrete time Fourier series.

Discrete Fourier Transform

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

Fast Fourier Transform

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

Discrete time systems implementation

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

Design of Digital Filters

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

Multirate Signal Processing

Down sampling and Up sampling, Decimation and Interpolation

Biomedical Applications

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

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

Sessional (20%)

Quizzes/ Test(s) (10%)

Assignment(s)/Project/ Presentation (10%)
Mid Semester (20%)
Final Semester (60%)

- **Laboratory (100%)**

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

Text and Reference Books:

1. Biomedical Signal Analysis, Ranagaraj M. Rangayyan, Willey- IEEE Press, latest edition.
2. Biomedical Signal Analysis: Contemporary methods and Applications, Fabian J, Theis and Anke Meyer, The MIT Press Cambridge, Massachusetts.
3. Biomedical Signal Processing: Principles and Techniques. D. C.Reddy.
4. Fundamentals of Digital Signal Processing. by: Joyce Van deVegte.
5. Digital Signal Processing: Fundamentals and Applications. by: Li Tan, latest edition.

BM304- Biomedical Instrumentation II

Contact Hours:
Theory = 45
Practical= 45
Total= 90

Credit Hours:
Theory = 3.0
Practical = 1.0
Total = 4.0

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

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

Course Outline:

Blood Pressure Measurement

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

Cardiac Devices

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

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

Instrumentation of Auto Drug Delivery System

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

Hemodialysis Machine

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

Ventilator

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

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

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

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

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

- **Laboratory (100%)**

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

Practical:

The topic related to theory will be covered in practical.

Recommended Text and Reference Books:

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

BM305- Medical Device Quality Systems and Standards

Contact Hours:
Theory = 45
Practical= 00
Total= 45

Credit Hours:
Theory = 3.0
Practical = 0.0
Total = 3.0

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

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	**Describe** the product development process for medical devices in industrial context	Cognitive	2	1
2.	**Explain** the regulatory approval process and key regulatory agencies (FDA, MDD, ISO etc.) for medical devices	Cognitive	2	6
3.	**Establish** product requirements, safety, and risk analysis, liability	Cognitive	2	12

Course Outline:

Introduction

Medical device as an entity; brief history of medical devices; current medical devices; Food and Drug Administration; Medical Device Directives.

Medical Devices Specifying the Product

Product definition process; QFD; business proposal; Requirement engineering; product specification; design specification; software requirements specification; safety and risk management; liability; Patents; copyrights; trademarks; trade secrets.

Product Designing

Six sigma and product design; methodologies; robust design; Hardware design; software design; software coding; Human factors design considerations.

Reliability

Historical perspective; quality vs. reliability; concept of failure; causes of failure;

practical aspects of failure; hardware and software failure; failure due to human error.

Regulations and Standards

History of device regulations; FDA; device classification; registrations and listing; pre-market approvals; Investigation device exemptions (IDEs); Medical Devices Directives (MDD); application of CE mark; quality system regulation; Domestic and International standards.

Testing and Data Analysis

Types of testing; testing protocols and methodologies; Hardware and software verification and validation; Analysis of test results.

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. A Complete Guide to Quality Management in the Medical Device Industry, Itay Abuhav

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	7
3.	**Analyze** Monte Carlo Simulation and Cellular Automata and be able to **examine** Network and Agent based models	Cognitive	4	4
4.	**Apply** modelling and simulation to Real-World Events, physiological, electrical, mechanical problems and find solutions of linear and nonlinear equations and the solution of differential equations in life sciences.	Psychomotor	2	11

Course Outline:

Introduction

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

models and combining of basic elements of conceptual models e.g., heart, muscles, eye etc. Hierarchical and integrated Models.

Mathematical Models

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

Application of Modeling and Simulation in Physiological System

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

Practical:

The topic related to theory will be covered in practical.

Suggested Assessment:

- **Theory (100%)**

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

- **Laboratory (100%)**

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

Text and Reference Books:

1. Modeling and simulation in biomedical engineering, Willem Van Meurs, latest edition.

2. Physiological Modeling: An Introductory Course for Biomedical Engineers , John Enderle, latest edition.
3. Advances in Numerical Heat Transfer, Volume 3, W. J. Minkowycz, latest edition.
4. Introduction to Modeling in Physiology and Medicine, Claudio Cobelli and Ewart Carson, , latest edition.
5. Modeling and Simulation in Medicine, Frank C. Hoppen steadt, Charles S. Peskin, latest edition.

BM307- Biomaterials

Contact Hours:
Theory = 45
Practical= 45
Total= 90

Credit Hours:
Theory = 3.0
Practical = 1.0
Total = 4.0

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

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

Course Outline:

Overview

Historical development and impact of biomaterials.

Structure and Properties of Materials

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

Metals

Introduction to ferrous and non-ferrous metals; steel and its alloys; rare earth metals;

types of nonferrous alloys; corrosion and degradation of materials; biocompatibility of materials.

Ceramics

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

Polymers and Biopolymers

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

Composites Material

Anisotropy; particulates; fibrous and porous materials; biocompatibility.

Applications of Biomaterials in Different Fields of Medicine

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

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

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

- **Laboratory (100%)**

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

Recommended Texts and Reference Books:

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.

MTH421- Engineering Management

Contact Hours:
Theory = 30
Practical= 00
Total= 30

Credit Hours:
Theory = 2.0
Practical = 0.0
Total = 2.0

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

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

Course Outline

1. Introduction to Engineering Management
   a. Role of Engineer in Management;
   b. Functions of Management
   c. Planning and Techniques of Management

2. Organizational Management Engineering
   a. Organizing Engineering and Structure
   b. Establishment of working relationship
   c. Market for engineering products
   d. Types of Markets

3. Managerial Decision Making and Management of Operations
   a. Efficient Managerial Decision in Healthcare setting
   b. Simulation Modeling of Healthcare delivery
   c. Simulation Applications in Healthcare setting
   d. Modeling clinical engineering activities to support healthcare technology management

4. Management and Supervision
   a. Principles of Hospital management
   b. Legal, Professional and Ethical Aspects
   c. Resources, duties and functions of medical and paramedical staff

d. Planning, Knowledge of various Hospital services

5. Cost and Quality Management

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

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

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

Recommended Books:

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

BM401- Medical Imaging

Contact Hours:
Theory =30
Practical=45
Total=75

Credit Hours:
Theory = 2.0
Practical = 1.0
Total = 3.0

COURSE LEARNING OUTCOMES:

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

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

Course Outline:

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

X-Ray

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

Technical mechanism; Structure and Applications: X-Ray tube design; X-Ray generator; basics of film/screen radiography; properties of film/screen cassettes; basic

theory of film processing; latent image formation; wet and dry processing; propagation model; biological relevant measure for energy transfer; biological damage from ionization. Applications of X-Ray imaging.

Ultrasound

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

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

Computed Tomography (CT)

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

Magnetic Resonance Imaging (MRI)

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

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

Nuclear Medical Imaging

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

Digital Image Processing

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

Practical:

The topic related to theory will be covered in practical.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments
- Report Writing

Suggested Assessment:

- **Theory (100%)**

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

- **Laboratory (100%)**

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

Text and Reference Books:

1. Bush berg J.T., The Essential Physics of Medical Imaging 3rdEd.
2. Z. H. Cho, Foundations of Medical Imaging
3. Biomedical Imaging (Principles & Application Engg: Series).
4. Digital Image Processing for Medical Applications, Geoff Dougherty, Cambridge University Press978-0-521-86085-7

ES410- Power Electronics

Contact Hours:
Theory =45
Practical=45
Total=90

Credit Hours:
Theory = 3.0
Practical = 1.0
Total = 3.0

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

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	**Discuss** the 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.

BM402- Rehabilitation Engineering

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 domains of rehabilitation engineering.	Cognitive	2	1
2.	**Describe** limb Prosthetic devices, orthotic devices, devices for visually impaired, and devices for hearing Impairment	Cognitive	2	1
3.	**Under supervision,** conduct experiments for analysis of physiological parameter during electrical stimulation.	Psychomotor	3	2
4.	**Recognize** assistive devices for hearing and visually impaired population.	Psychomotor	1	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 wheel chairs 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. Wheel chair standards

7. Neuro rehabilitation

a. Functional Electrical Stimulation
b. Transcutaneous Electrical Stimulation
c. Brain Computer Interface
d. Assessment methods for neuro rehabilitation

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. Rory A Cooper and Hisaichi Ohnabe, An Introduction to Rehabilitation Engineering, latest edition.
2. Pedro Encarnação and Albert Cook, Robotic Assistive Technologies: Principles and Practice, latest edition.
3. Marko B. Popović, Biomechanics and Robotics, latest edition.
4. Albert M. Cook and Janice Miller Polgar, Assistive Technologies: Principles and Practice, latest edition.
5. Kevin Russell Henderson,Wheel chairs: Perceptions, Technology Advances and Barriers, latest edition.
6. Michelle M. Lusardi, Orthotics and Prosthetics in Rehabilitation, latest edition.

MTH422- Technical Report 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.	**Demonstrate** the ability to create various types of technical documents, including essays, proposals, research papers, and technical reports, with an emphasis on clarity, consistency, and appropriate style	Cognitive	6	1
2.	**Demonstrate** presentation skills and the ability to write academic essays, research proposals, and progress reports, focusing on content, language, form, and adherence to academic standards.	Cognitive	3	10

Course Outline:

1. Presentation skills
   a. Essay writing (Descriptive, narrative, discursive, argumentative)
2. Academic writing
3. How to write a proposal for research paper/Semester paper
4. How to write a research paper/Semester paper (emphasis on style, content, language, form, clarity, consistency)
5. Technical Report writing
6. Progress report writing

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. Patterns of College Writing by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Pres, latest edition.
2. The Mercury Reader. A Custom Publication. Compiled by Norther Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton, latest edition.
3. Writing. Advanced by Ron White. Oxford Supplementary Skills, latest edition. (particularly suitable for discursive, descriptive, argumentative and report writing).
4. College Writing Skills by John Langan. McGraw-Hill Higher Education, 2004.

BM411- Final Year Design Project-I

Contact Hours:
Theory = 00
Practical = 135
Total = 135

Credit Hours:
Theory = 0.0
Practical = 3.0
Total = 3.0

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

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

BM403- 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.	**Discuss** the wide range of applications of nanotechnology and its interdisciplinary aspect. Also, explain principles governing the effect of size on material properties at the nanoscale, and perform quantitative analysis	Cognitive	2	1
2.	**Describe** how cells use these "soft machines" for generating energy, motion, synthesizing biomolecules	Cognitive	2	1
3.	**Correlate** the impact of nanotechnology and nanoscience in a global, economic, environmental, and societal context	Cognitive	4	12

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. **Bio nano materials**
   a. Biological building blocks
   b. Bio nano structures (nanofibers, nanotubes, nanocellulose)
4. **Biological nano machines**
   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. Quantum dots, liquid crystals

e. Nanoporous materials (metalic, zeolite, MOFs)

6. **Microfabrication methods** (photolithography, soft lithography, replication):

7. **Nanofabrication methods** (Top-Down approaches)

8. **Nanotechnology by self-assembly**:
   a. (Bottom-Up approach): Principles, thermodynamics, interactions, properties
   b. Supra molecular self-assembly
   c. Protein nanotechnology
   d. DNA nanotechnology

9. **Microfluidics**
   a. Surface tension
   b. Capillarity
   c. Reynolds number
   d. Diffusion,
   e. Viscosity

10. **Nano fluidics**
    a. Nanopores and nanocapillaries
    b. Debye length

11. **Diffusion in solid phase and drug delivery**

12. **Biological and medical micro devices**
    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%)
Quizzes/ Test(s) (10%)
Assignment(s)/Project/ Presentation (10%)
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; pp1-55.
2. Brydson, R. M.; Hammond, C., Generic Methodologies for Nanotechnology: Characterization. In Nanoscale Science and Technology, John Wiley & Sons, Ltd: 2005; pp56-129.
3. Leggett, G. J.; Jones, R. A. L., Bio nanotechnology. In Nanoscale Science and Technology, John Wiley & Sons, Ltd: 2005; pp419-445.
4. Bucke, C., Bio nanotechnology—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 Bio nanotechnology, John Wiley & Sons, Inc.: 2004; ppi- xii.
6. Gibbs, M. R. J., Nanomagnetic Materials and Devices. In Nanoscale Science and Technology, John Wiley & Sons, Ltd: 2005; pp203-236.
7. Gerrard, J. A., Protein Nanotechnology: Protocols, Instrumentation, and Applications, Second Edition. Humana Press: Totowa, NJ,2013.
8. Marie, R.; Kristensen, A., Nanofluidic devices towards single DNA molecule sequence mapping. Journal of Bio photonics 2012, 5 (8-9),673-686.

MTH423- Professional Practices & Ethics

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.	**Discuss** the contemporary frameworks of professional and engineering ethics in the light of ethical theories and dilemmas.	Cognitive	2	8
2.	**Apply** principles, theories, and codes of ethics in situations related to professional practice.	Cognitive	3	8
3.	**Value** professional, aspirational, and collective ethics for continual professional development.	Affective	3	8

Course Outline:

1. Professional Practices
   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. Quality Management Process
d. Defining SLAs for an engineering project
e. Performance Reporting

5. Planning

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

6. Professional Ethics

a. Ethical responsibilities of 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.

BM404- Medical Image Processing

Contact Hours:
Theory =30
Practical=45
Total=75

Credit Hours:
Theory = 2.0
Practical = 1.0
Total = 3.0

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

Sr. No.	CLO	Domain	Taxonomy level	PLO
1.	**Discuss** the basic knowledge of fundamentals of Medical Image Processing techniques (spatial domain, frequency domain, noise removal, image reconstruction and image segmentation).	Cognitive	1	1
2.	**Analyze** the medical image to remove noise	Cognitive	4	2
3.	**Under supervision** demonstrate filtration techniques on different medical images using software tools.	Psychomotor	3	5
4.	**Under supervision perform** the segmentation on different medical images using software tools.	Psychomotor	3	5

Course outline:

1. Digital Image Fundamental
   a. Image file formats
   b. Elements of Visual Perception
   c. Image Sampling and Quantization
   d. An Introduction to the Mathematical Tools Used in Digital Image Processing

2. Intensity Transformations and Spatial Filtering
   a. Basic Intensity Transformation Functions
   b. Histogram Processing
   c. Fundamentals of Spatial Filtering
   d. Smoothing Spatial Filters
   e. Sharpening Spatial Filters

3. Filtering in the Frequency Domain
   a. Review of Concept about Fourier in1D
   b. Fourier Functions of Two Variable
   c. The Basics of Filtering in the Frequency Domain
   d. Image Smoothing Using Frequency Domain Filters
   e. Image Sharpening Using Frequency Domain Filters

4. Image Restoration and Reconstruction

a. Noise Models
b. Restoration in the Presence of Noise Only-Spatial Filtering
c. Periodic Noise Reduction by Frequency Domain Filtering
d. Inverse Filtering, Least Squares Filtering, GM filtering
e. Image Reconstruction from Projections

5. Image Segmentation

a. Point, Line, and Edge Detection
b. Thresholding
c. Region-Based Segmentation
d. Segmentation Using Morphological Watersheds
e. The Use of Motion in Segmentation

6. Image Compression

a. Compression Standards
b. Some Basic Compression Methods (Huffman Coding, Golomb Coding)

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

MTH424- Entrepreneurship

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** basic functions and importance of entrepreneurship	Cognitive	2	12
2.	**Value** business ethics on entrepreneurial activities.	Affective	3	8
3.	**Demonstrate** the entrepreneurial skills to develop business plan	Affective	3	11

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

Suggested Teaching Methodology:
- Lecturing
- Guest lectures
- Project

Suggested Assessment:
- **Theory (100%)**

Sessional (20%)
Quizzes/ Test(s) (10%)
Assignment(s)/Project/ Presentation (10%)
Mid Semester (20%)

Final Semester (60%)

Text and Reference Books:

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

BM412- Final Year Design Project-II

Contact Hours:
Theory = 00
Practical= 135
Total= 135

Credit Hours:
Theory = 0.0
Practical = 3.0
Total = 3.0

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

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