NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering in Biomedical

DEPARTMENTAL OUTCOME BASED EDUCATION (OBE) CATALOGUE

Batch 2021 and Onwards

Contents

1. Vision Statement

a. University Vision

Be a leader in enabling Pakistan's social and economic transformation.

b. Department Vision

To be a leader in disseminating insightful knowledge and facilitating distinguished research in the field.

2. Mission Statement

a. University Mission

Acquire education and research excellence in engineering and allied disciplines to produce leadership and enabling application of knowledge and skills for the benefit of the society with integrity and wisdom.

a. Programme Mission

To produce graduates able to strengthen the Biomedical Engineering and allied sciences through a combination of educational, professional, and ethical values, and driving innovation by taking leadership roles in academia and industry.

3. Program Educational Objectives (PEOs)

Graduates of the BE Biomedical Engineering programme at NED University of Engineering and Technology will demonstrate:

PEO-1: Knowledge and skills to analyze problems and provide solutions aimed at improving the quality of life using state-of-the-art technology.

PEO-2: Leadership and interpersonal skills with ethical values for industrial and academic growth.

PEO-3: Dynamism to enhance careers by embarking on a lifelong journey of expanding knowledge, bringing about global sustainability along with societal impact.

4. Mapping of PEOs to University and Departmental Vision and Mission

Vision and Mission		Program Educational Objectives (PEOs)		
		PEO-1	PEO-2	PEO-3
University Vision	Be a leader[2] in enabling Pakistan's social[3] and economic transformation[1].	✓	✓	✓
University Mission	Acquire education and research excellence in engineering and allied disciplines to produce leadership[2] and enabling application of knowledge and skills[1] for the benefit of the society[3] with integrity and wisdom.	✓	✓	✓
Department's Vision	To be a leader[2] in disseminating insightful knowledge[1] and facilitating distinguished research in the field[3].	✓	✓	✓
Programme's Mission	To produce graduates able to strengthen the Biomedical Engineering[1] and allied sciences through a combination of educational, professional, and ethical values, and driving innovation by taking leadership[2] roles in academia and industry[3].	✓	✓	✓

5. Program Learning Outcomes (PLOs)

The following graduate attributes as defined by PEC, have been adopted as Program Learning Outcomes (PLOs) by the department.

PLO-1 Engineering Knowledge: An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PLO-2 Problem Analysis: An ability to identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PLO-3 Design / Development of Solutions: An ability to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PLO-4 Investigation: An 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.

PLO-5 Modern Tool Usage: An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations.

PLO-6 The Engineer and Society: An 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.

PLO-7 Environment and Sustainability: An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

PLO-8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PLO-9 Individual and Teamwork: An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.

PLO-10 Communication: An 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 documentation, make effective presentations, and give and receive clear instructions.

PLO-11 Project Management: An 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.

PLO-12 Lifelong Learning: An ability to recognize importance of and pursue lifelong learning in the broader context of innovation and technological developments.

6. Mapping of PLOs to PEOs

Program Learning Outcomes (PLOs)	Program Educational Objectives (PEOs)		
	PEO-1	PEO-2	PEO-3
PLO 1: Engineering Knowledge	✓		
PLO 2: Problem Analysis	✓		
PLO 3: Design / Development of solutions	✓		
PLO 4: Investigation			✓
PLO 5: Modern Tool Usage	✓		
PLO 6: The Engineer and Society			✓
PLO 7: Environment and Sustainability			✓
PLO 8: Ethics		✓	
PLO 9: Individual and Team Work		✓	
PLO 10: Communication		✓	
PLO 11: Project Management		✓	
PLO 12: Lifelong Learning			✓

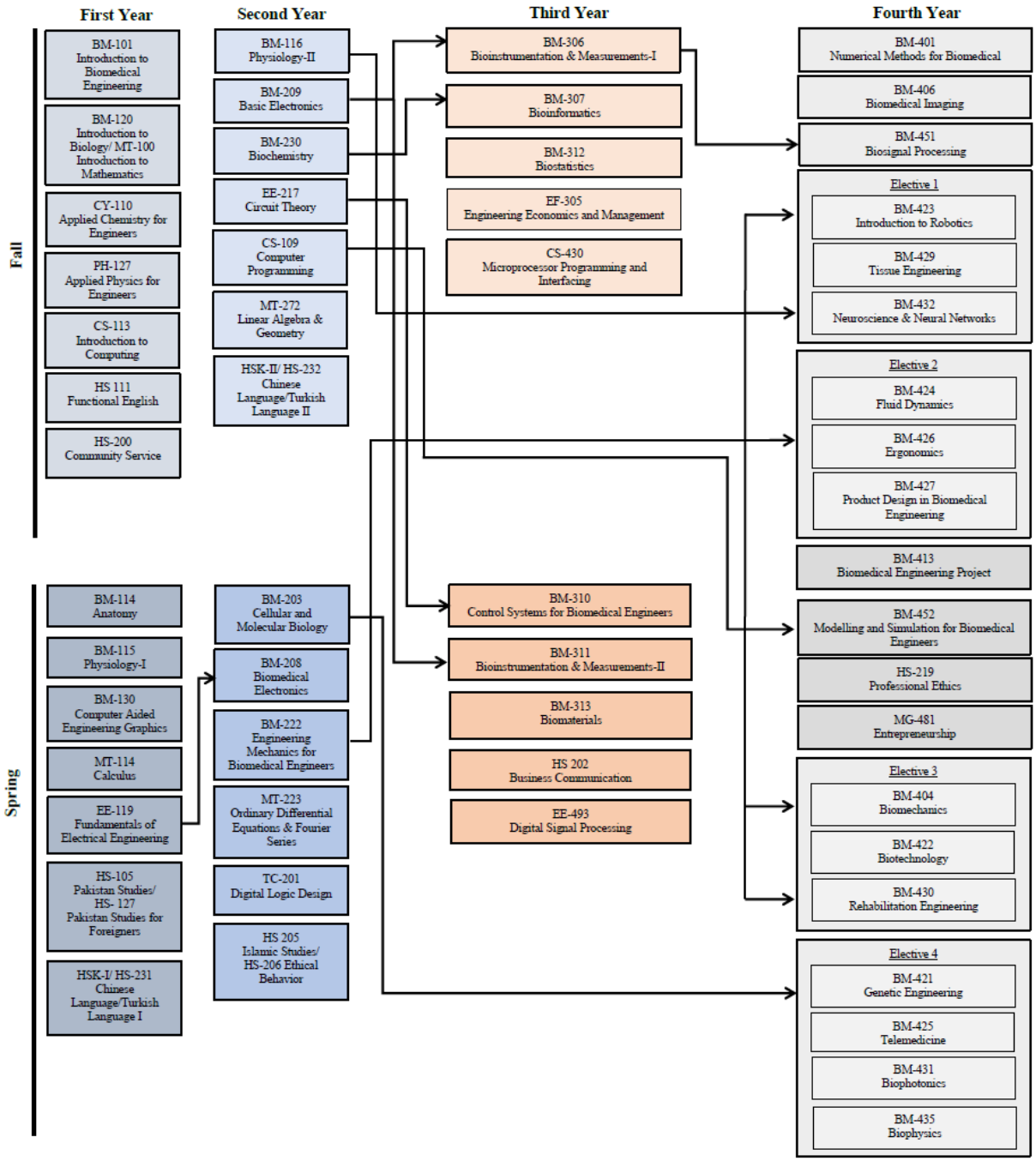
7. Scheme of Studies of Biomedical Engineering

Biomedical Engineering									
First Year									
Fall Semester					**Spring Semester**				
Course Code	**Course Title**	**Credit Hrs**			**Course Code**	**Course Title**	**Credit Hrs**		
		Th	**Pr**	**Total**			**Th**	**Pr**	**Total**
BM-120/ MT-100	Introduction to Biology (3+1) or Introduction to Mathematics (4+0)	4	0	4	MT-114	Calculus	3	0	3
BM-101	Introduction to Biomedical Engineering	1	0	1	EE-119	Fundamentals of Electrical Engineering	3	1	4
CY-110	Applied Chemistry for Engineers	2	1	3	BM-114	Anatomy	3	1	4
PH-127	Applied Physics for Engineers	2	1	3	BM-115	Physiology-I	2	1	3
CS-113	Introduction to Computing	1	1	2	HS-105/ HS-127	Pakistan Studies (PS)/ PS for Foreigners	2	0	2
HS-111	Functional English	2	0	2	BM-130	Computer Aided Engineering Graphics	1	1	2
					HSK-I /HS-231	Chinese Language / Turkish Language I	NC		
	Total	**12**	**3**	**15**		**Total**	**14**	**4**	**18**
Second Year									
Fall Semester					**Spring Semester**				
Course Code	**Course Title**	**Credit Hrs**			**Course Code**	**Course Title**	**Credit Hrs**		
		Th	**Pr**	**Total**			**Th**	**Pr**	**Total**
EE-217	Circuit Theory	2	0	2	BM-222	Engineering Mechanics for Biomedical Engineers	3	0	3
BM-209	Basic Electronics	3	1	4	MT-223	Ordinary Differential Equations & Fourier Series	3	0	3
CS-109	Computer Programming	2	1	3	BM-203	Cellular and Molecular Biology	2	0	2
MT-272	Linear Algebra & Geometry	3	0	3	TC-201	Digital Logic Design	2	1	3
BM-230	Biochemistry	2	1	3	HS-205/ HS-206	Islamic Studies or Ethical Behavior	2	0	2
BM-116	Physiology-II	2	1	3	BM-208	Biomedical Electronics	3	1	4
HSK-II /HS-232	Chinese Language / Turkish Language II	NC			HS-200	Community Service	NC		
	Total	**14**	**4**	**18**		**Total**	**15**	**2**	**17**

Third Year									
Fall Semester					**Spring Semester**				
Course Code	**Course Title**	**Credit Hrs**			**Course Code**	**Course Title**	**Credit Hrs**		
		Th	**Pr**	**Total**			**Th**	**Pr**	**Total**
BM-312	Biostatistics	2	1	3	BM-310	Control Systems for Biomedical Engineers	2	1	3
EF-305	Engineering Economics and Management	3	0	3	BM-311	Bioinstrumentation & Measurements-II	3	1	4
BM-306	Bioinstrumentation & Measurements-I	3	1	4	HS-202	Business Communication	3	0	3
CS-430	Microprocessor Programming and Interfacing	3	1	4	BM-313	Biomaterials	3	1	4
BM-307	Bioinformatics	2	1	3	EE-493	Digital Signal Processing	3	1	4
	Total	**13**	**4**	**17**		**Total**	**14**	**4**	**18**
Final Year									
Fall Semester					**Spring Semester**				
Course Code	**Course Title**	**Credit Hrs**			**Course Code**	**Course Title**	**Credit Hrs**		
		Th	**Pr**	**Total**			**Th**	**Pr**	**Total**
BM-###	*Elective 1*	2	1	3	BM-413	Biomedical Engineering Project	0	3	3
BM-401	Numerical Methods for Biomedical Engineering	3	0	3	MG-481	Entrepreneurship	3	0	3
BM-406	Biomedical Imaging	2	1	3	BM-452	Modelling and Simulation for Biomedical Engineers	2	1	3
BM-451	Biosignal Processing	2	1	3	BM-###	*Elective 3*	2	1	3
BM-###	*Elective 2*	3	0	3	HS-219	Professional Ethics	2	0	2
BM-413	Biomedical Engineering Project*	0	3	3	BM-###	*Elective 4*	3	0	3
	Total	**12**	**6**	**18**		**Total**	**12**	**5**	**17**
** Duration one academic year: Requires literature survey and preliminary work during this Semester*									

ELECTIVES				
Course Code	**Course Name**	**Credit Hours**		
		Theory	**Practical**	**Total**
Elective 1				
BM-423	Introduction to Robotics	2	1	3
BM-429	Tissue Engineering	2	1	3
BM-432	Neuroscience & Neural Networks	2	1	3
Elective 2				
BM-424	Fluid Dynamics	3	0	3
BM-426	Ergonomics	3	0	3
BM-427	Product Design in Biomedical Engineering	3	0	3
Elective 3				
BM-404	Biomechanics	2	1	3
BM-422	Biotechnology	2	1	3
BM-430	Rehabilitation Engineering	2	1	3
Elective 4				
BM-421	Genetic Engineering	3	0	3
BM-425	Telemedicine	3	0	3
BM-431	Biophotonics	3	0	3
BM-435	Biophysics	3	0	3

Mapping of Pre-requisite Courses



8. Mapping of Curriculum to PLOs

		BE Biomedical Engineering Courses		Program Learning Outcomes (PLOs)											
		Course Code	Course Title	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10	PLO-11	PLO-12
First Year	Fall	BM-120	Introduction to Biology (3+1) or	C1	C2										
		MT-100	Introduction to Mathematics (4+0)	C1	C2										
		BM-101	Introduction to Biomedical Engineering	C1					C2		C2				
		CY-110	Applied Chemistry for Engineers	C2,P3	C3										
		PH-127	Applied Physics for Engineers	C2,P3	C3										
		CS-113	Introduction to Computing	C2				P2							
		HS-111	Functional English										A3,C2, C6		
	Spring	MT-114	Calculus	C1	C2,C3										
		EE-119	Fundamentals of Electrical Engineering	C1	C3		P2								
		BM-114	Anatomy	C2	C3							C4			
		BM-115	Physiology-I	C1,C2	P1									C2	
		HS-105/ HS-127	Pakistan Studies (PS)/ PS for Foreigners						C2						C2
		BM-130	Computer Aided Engineering Graphics	C2				P3							
		HSK-I /HS-231	Chinese Language/ Turkish Language I												
Second Year	Fall	EE-217	Circuit Theory	C2	C3										
		BM-209	Basic Electronics	C1	C2			P2				A3			
		CS-109	Computer Programming	C2		C3		C3							
		MT-272	Linear Algebra & Geometry	C2	C3										
		BM-230	Biochemistry	C1			C3				P3				
		BM-116	Physiology-II	C2,P1			C4						C2		
		HSK-II /HS-232	Chinese Language/ Turkish Language II												
	Spring	BM-222	Engineering Mechanics for Biomedical Engineers	C2	C3		C3								
		MT-223	Ordinary Differential Equations & Fourier Series	C2	C3										
		BM-203	Cellular and Molecular Biology	C1								A3	C2		
		TC-201	Digital Logic Design	C2		C4	P3								
		HS-205/ HS-206	Islamic Studies or Ethical Behavior								C2				
		BM-208	Biomedical Electronics	C2		C5		P3							C2
		HS-200	Community Service						A3						A2

		BE Biomedical Engineering Courses		Program Learning Outcomes (PLOs)											
		Course Code	Course Title	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10	PLO-11	PLO-12
Third Year	Fall	BM-312	Biostatistics	C2	C2				P3						C3
		EF-305	Engineering Economics and Management							C2	C1			C3	
		BM-306	Bioinstrumentation & Measurements-I	C2		P3						A4		C5	
		CS-430	Microprocessor Programming and Interfacing	C3	C4			C3							
		BM-307	Bioinformatics	C2			C4			C2					
	Spring	BM-310	Control Systems for Biomedical Engineers	C2	C3		C5					P2			
		BM-311	Bioinstrumentation & Measurements-II	C1		C2			P2	A4					
		HS-202	Business Communication										A3,C3, C6		
		BM-313	Biomaterials	C1		C2		P1		C3					
		EE-493	Digital Signal Processing	C1		C6	C4,P3								
Fourth Year	Fall	BM-xxx	Elective 1	C2	P2						C2				
		BM-401	Numerical Methods for Biomedical Engineering	C3	C4		C3								
		BM-406	Biomedical Imaging	C2	C3		P3		A4						
		BM-451	Biosignal Processing	C2	P3					C3					
		BM-xxx	Elective 2	C1					C2						C2
		BM-413	Biomedical Engineering Project		C	C				C	A	A	A	A	
	Spring	BM-413	Biomedical Engineering Project		C	C					A	C,A	C,A	C	C
		MG-481	Entrepreneurship								A3			C3	C2
		BM-452	Modelling and Simulation for Biomedical Engineers	C2			C4			A4				P2	
		BM-xxx	Elective 3	C3	P2				C3						
		HS-219	Professional Ethics								C2,C3, A3				
		BM-xxx	Elective 4	C1					C2						C2
			Internship	C	C				A		A	A	A		

9. Key Performance Indicators (KPIs)

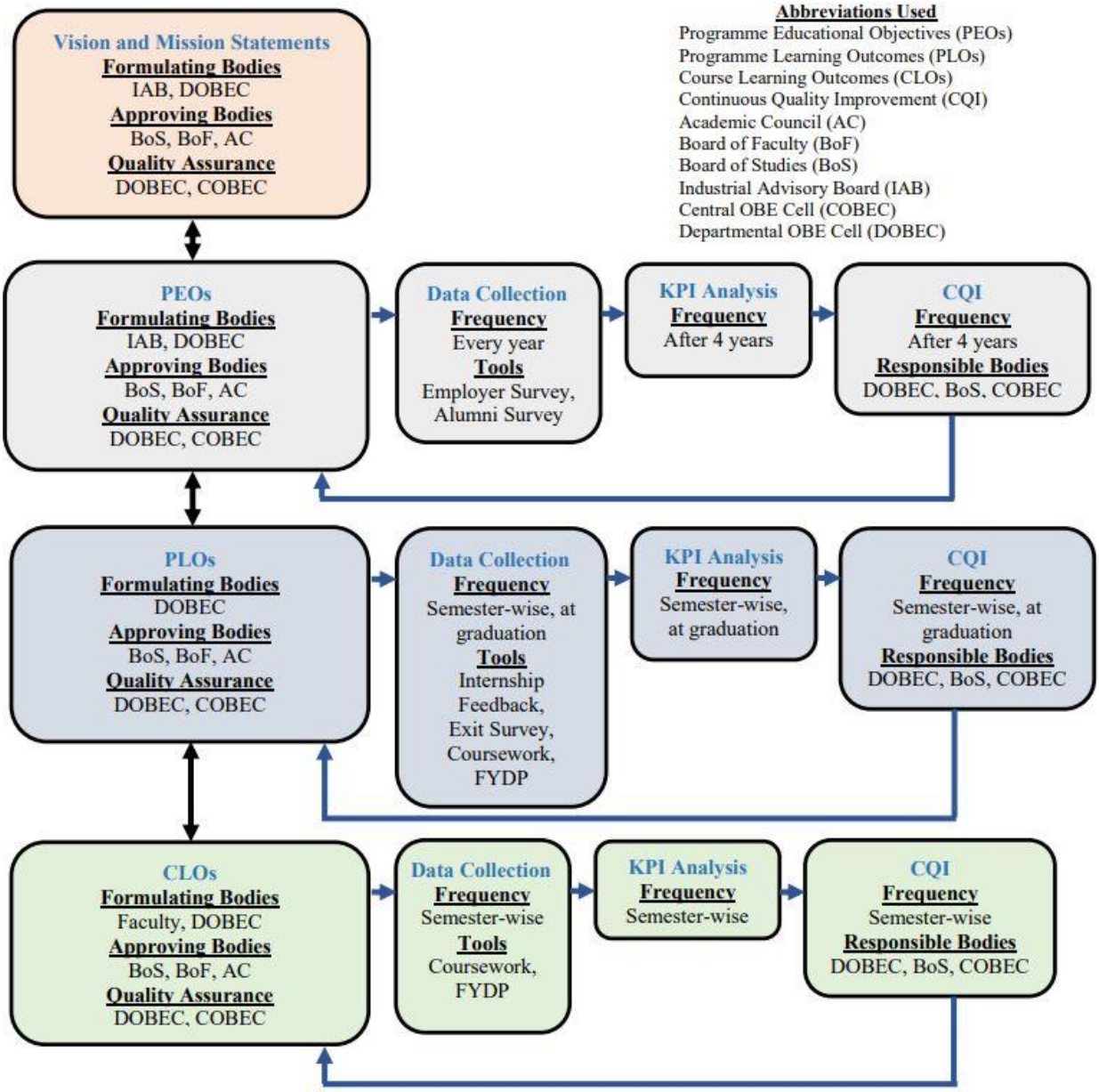
		Evaluation Tool	KPI	Data Collection Frequency	Analysis Frequency
PEO	Programme	▪ Employer Feedback Survey ▪ Alumni Feedback Survey ▪ Employment Statistics	50% of the Survey Form responses must attain a score of 3 or above (on a scale of 1 to 5), and 50% of the graduates must be employed and/or engaged in higher studies.	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	Every Semester	Every Semester
	Programme	▪ Final PLO attainment statistics of all the courses including FYDP ▪ Internship Feedback Form ▪ Exit Survey	At least 50% of the mapped courses must attain the PLO and at least 50% of the students/ responses must attain a score of 3 or above on a scale of 1 to 5.	At graduation	At 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	Every Semester	Every Semester

10.Continuous Quality Improvement (CQI)

The following table shows the post KPI evaluation actions, severity-wise, as outlined in the Manual of Uniform OBE Framework.

	PEO CQI	PLO CQI			CLO CQI	
	Program KPI	**Student KPI**	**Course KPI**	**Programme KPI**	**Student KPI**	**Course KPI**
KPIs Achieved	▪ No Action	▪ No Action	▪ No Action	▪ No Action	▪ No Action	▪ No Action
KPIs Not Achieved	1. Review of curriculum strategies. 2. Review of assessment methods. 3. Review of the relevant KPIs. 4. Review of PEOs. 5. Revisions implemented.	1. Warning through the progressive attainment sheet. 2. Student counselling.	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. 5. Revisions implemented.	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. 5. Revisions implemented.	1. Student provided further chances through direct assessment tools. 2. Student counselling.	1. Review of CLO assessment methods. 2. Review of CLOs and taxonomy levels. 3. Review of students' course feedback. 4. Review of CLO KPIs. 5. Faculty advice by Departmental OBE Cell. 6. Faculty training.

The following figure shows the overall OBE framework for an Engineering Programme as outlined in the Manual of Uniform OBE Framework.



11.Course Profiles

Course Profiles for Batch 2021 and Onwards

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE& TITLE **BM-101 Introduction to Biomedical Engineering**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 □2 ■1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Goals of Biomedical Engineering

Overview of Biomedical Engineering areas and applications

Overview of human biology

Introduction to basic areas using application examples (Bioinstrumentation, Biomedical Sensors, Biomedical signal processing, biological systems modeling, Biomechanics, Rehabilitation Engineering, Biomaterials, Tissue Engineering, Genomics and bioinformatics, Computational biology, Medical imaging, Implants, Telemedicine)

Ethical responsibilities of biomedical engineer.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	UNDERSTAND and appreciate the world of biomedical engineering and its applications for the benefit of humanity	C1	1
2	EXPLAIN challenges faced by biomedical engineers in society	C2	6
3	DESCRIBE moral and ethical issues in biomedical engineering	C2	8

REMARKS (if any):

Recommended by: _____ **Approved by:** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **BM-114 Anatomy**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Anatomical Terminology and Methods

Descriptive anatomical terms; radiographic anatomy.

Skeleton

Upper limbs; chest; head and neck.

Skeleton Muscles

Anatomy of major muscles; muscle groups of upper limbs, head, neck, muscle of chest, muscle groups of lower limb, abdomen, and muscle of back.

Joints

Muscle groups and ligaments; movement and stability, shoulder, wrist, elbow and finger joints, hip, knee, and ankle joints.

Hands and Feet

The hand and feet as functional unit.

The Nervous System

Neuron types; gross anatomy of the brain and spinal cord; regions of the brain.

Cerebral cortex; cerebellum; brainstem; spinal cord; peripheral nervous system; sense organs

The Cardiovascular System

Anatomy of heart and blood vessels

The Respiratory System

Upper and lower respiratory tracts; gross and fine anatomy of the lungs.

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The Gastrointestinal System

Organization of digestive system; mouth, esophagus, intestines, liver, gallbladder, and pancreas.

The Urinary System

Gross and fine anatomy of kidney and adrenal glands.

The Lymphatic System

Anatomy of lymph nodes, thymus, spleen, vessels and flow.

Skin

Layering of the skin

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	DESCRIBE the human bones, muscles and joint's structure and relations	C2	1
2	ILLUSTRATE and RELATE the functional activities of human body like movement of different joints for different daily life activities	C3	2
3	ANALYZE and DIFFERENTIATE the normal and abnormal functional activities of human body through teamwork including measurements or searching the research articles	C4	9

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **BM-115 Physiology I**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Introduction to Physiology:

Functional organization of human body

Cell & its function

Cell growth & reproduction

Cell to Cell adhesions and cellular communication

Cellular metabolism

Transport through cell membrane

Control of homeostasis

Human physiology from a system's viewpoint:

Quantitative issues at organ and whole-body level:

Cardiovascular Respiratory, Renal and Digestive systems

Nerve and Muscle:

Membrane potential, Action potential, Muscle Cells and their functions, Mechanism of muscle contraction, the neuromuscular junction, muscle action potential, motor control.

Endocrine & Reproduction

Harmons and their role (pituitary hormone), Regularity functions of endocrine systems

Hormonal functions in male and female

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	DEFINE and UNDERSTAND the concepts of functioning of the physiological systems of human body	C1	1
2	DESCRIBE and EXPLAIN the structural organization and functional integration of various activities of different systems of human body	C2	1
3	RECOGNIZE the normal and abnormal results of the experiments performed under supervision	P1	2
4	DESCRIBE concepts and project management knowledge related to functional combination of various activities of different system in human body.	C2	11

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **BM-116 Physiology-II**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TTH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Nervous System

Organization of Nervous System, Basic functions of synapses, neural network, the physiological bases of neural signaling.

Motor Functions of brain stem

Vestibular control of postural reflexes, cerebrum, basal ganglia, and reticular formation.

Sensory system

Sensory receptors; classification, basic mechanism of action, Sensory Sensation: mechanoreceptive sensations, pain, thermal and visceral pain.

Behavioral Functions of Brain

Limbic system, role of hypothalamus and control of vegetative functions of the body.

Autonomic Nervous System

Special Senses:

Vision: Receptive function of the retina, neurophysiology of vision.

Hearing: Physiological characteristics of sound. Auditory transduction.

Chemical Sense: Taste and Smell

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Course Profile

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	DESCRIBE and EXPLAIN the functional integration of various activities of different systems of human body	C2	1
2	INTERPRET and ASSOCIATE the functioning of the normal and abnormal physiological systems of human body	C2	10
3	ANALYSE and DISTINGUISH the normal and abnormal functions of different systems of human body	C4	4
4	RECOGNISE the normal and abnormal results of the experiments perform under supervision	P1	1

REMARKS (if any):

Recommended by : _____ **Approved by:_____**

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **BM-120 Introduction to Biology**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Introduction to Biology:

Biology; divisions of living organism; major branches of biology; levels of biological organization; biological methods; application of biology.

Unit of Life:

Cell and its organelles; chemical composition of cell; prokaryotes and eukaryotes; interphase and subdivision; mitosis and its significance; meiosis and its significance.

Variety of Life:

Classification; needs and bases of biological classification; concept of species and hierarchy of biological classification; viruses, discovery, characteristics, structure, and classification; life cycle of bacteriophage; viral diseases, transmission, spread and control; HIV and hepatitis.

The Five Kingdom System:

Kingdom Prokaryote (MONERA); bacteria, genetic recombination, importance, and control; immunization and vaccination.

Kingdom Protoctista (PROTISTA); diversity among Protista; classification; pathogenic protozoa; life cycle of malarial parasite.

Kingdom Fungi; body; nutrition; reproduction; economic importance.

Kingdom Plantae; classification; plants of medicinal importance.

Kingdom Animalia; diversity and complexity; animal classification.

Functional Biology:

Nutrition; types of nutrition; nutrition in amoeba, hydra, planaria and cockroach; nutrition in man; disorders of gastrointestinal tract of man.

Respiration:

Plant respiration (very short); respiratory organs of aquatic and terrestrial animals; transport of gases in man (respiratory system and process); role of hemoglobin and myoglobin.

Transport:

Need for transport; circulatory system of selected animals; circulatory system of man; structure of heart; blood vessels; blood pressure; cardiovascular disorders; lymphatic system and immune system.

Homeostasis:

Definition and need; osmoregulation, excretion and thermoregulation; excretion in amoeba, hydra, planaria, earthworm and cockroach; excretion in man; kidney problems.

Support & Locomotion:

Support and movement in man and animals; human skeleton, structure and function and deformities; skeleton related disease and bone repair; muscular system in man.

Coordination & Control:

Definition & need; nervous system of hydra; planaria, cockroach; co-ordination in animals; effects of drugs on co-ordination; nervous disorders, chemical co-ordination.

Reproduction:

Reproductive system in selected animals; reproductive systems of man; reproductive cycle; hormonal control of reproduction; sexually transmitted diseases.

Growth & Development:

Process of development; development of man; role of cytoplasm & nucleus in development; abnormal development.

Continuity of Life and Genetics and Variation:

Chromosomes & DNA, genes units of heredity; genes & alleles; Mendel's laws of inheritance; multiple alleles; linkage & crossing over; sex determination & sex; diabetes as an example of hereditary disease.

Evolution:

Theories of evolution; evidence of evolution

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	DEFINE basic biological concepts and life processes	C1	1
2	DESCRIBE the biological issues involving genetic and environmental factors	C2	2
3	EXPLAIN the results of experiments performed in the laboratory	C2	2

REMARKS (if any):

Recommended by: _____ **Approved by:** _____

(Chairperson/Date) (Dean/Date)

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Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **BM-130 Computer Aided Engineering Graphics**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 □2 ■1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Introduction to Computer Aided Drafting:

Introduction to the Engineering design Process, Technical Graphics basics, Orthographic projection and Isometric drawings and basic concepts of Conventional engineering drawings. Opening a new drawing, paper setting, coordinate systems: User's coordinate system (UCS), Cartesian coordinates and Polar coordinates; saving a drawing.

Creating Elementary Objects:

Apply the Commands: Grid, Ortho, Escape, Erase, Trim, Undo, Draw Lines, Circles, Ellipse, Rectangle And Arcs.

Basic Object Editing:

Apply the following commands: Move, offset, rotate, fillet, chamfer, array and mirror.

Dimensioning:

Show the following dimensioning: Linear, aligned, radial and changing dimensional setting.

Solid Modeling:

Apply the following commands to create 3-D models: Region, extrude, revolve, slice and show plan; elevation and end view of a 3-D model.

Controlling Drawings:

Apply the following commands for a given drawing: Hatching, coloring and rendering.

Text:

Apply the following commands on the given drawing: Creating text, style of text and changing text properties.

Plotting Drawings:

Apply the following commands: Plotting, print preview and printing.

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	Describe basics of engineering drawing and able to draw projections of 3D Models.	**C2**	1
2	Imitate 2D and 3D Models by using modern tools and commands	**P3**	5

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **BM-203 Cellular & Molecular Biology**	SEMESTER ■ SPRING □ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Introduction:

Review of biochemistry; review of organism classes; review of cellular structure; introduction to genetics; DNA, RNA, genes and the synthesis of proteins; structure of the genome in prokaryotes and eukaryotes.

Cellular Dynamics:

The cell cycle; mitosis; apoptosis.

Transcription in Prokaryotes:

RNA polymerase; promoters; dynamics of transcription; operations and control of transcription.

Transcription in Eukaryotes:

RNA polymerases and their functions; transcription factors; transcription activators and their interactions; regulation of transcription factors; gene regulation networks.

Post-transcriptional Events:

RNA splicing; capping and polyadenylation; ribosomal RNA processing; transfer RNA processing; post-transcriptional control of gene expression; gene silencing.

Translation:

Translation initiation in prokaryotes and eukaryotes; control of initiation; elongation and termination; ribosomes and transfer RNA (tRNA).

DNA Replication, Recombination and Transposition:

Overview of DNA replication processes; DNA damage and repair; initiation, elongation and termination; homologous meiotic recombination; site-specific recombination; transpositions in prokaryotes and eukaryotes.

Methods of Biotechnology:

Recombinant DNA technology; the polymerase chain reaction (PCR); gene cloning; gel electrophoresis; chromatography; labeled tracers; restriction enzymes; DNA sequencing; mapping transcripts.

Introduction to Genomics and Proteomics:

Introduction to bioinformatics; gene sequencing; gene discovery and functional genomics; protein sequencing and profiling; determining protein structure and function.

Molecular Biology and Disease:

Genetic diseases; the molecular basis of cancers; the molecular biology of aging; gene therapy.

Molecular Biology and Evolution:

The origin of life an earth; evolution of living organisms DNA alterations; increase in genome size; the organization of genome.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	Gain basic knowledge of the concepts in cell biology, genetics, and biotechnology	C1	1
2	Effectively COMMUNICATE general principles of gene expression, molecular pathology, and evolution	C2	10
3	EXPRESS the changes associated with the cellular and molecular biology of diseases and their effect on cellular structure/function	A3	9

REMARKS (if any):

Recommended by: _____ **Approved by: _____**

(Chairperson/Date) (Dean/Date)

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Course Profile

COURSE CODE& TITLE **BM-208 Biomedical Electronics**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **EE-119 Fundamentals of Electrical Engineering**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

MOSFET:

MOS as an amplifier; small signal operation; MOS configuration; MOS internal capacitance.

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.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	EXPLAIN working of amplifiers, oscillators, and signal conditioning circuits.	C2	1
2	ANALYZE and COMPARE electronics circuits used for amplification, wave shaping, and filtration.	C5	3

3	CONDUCT experiments on their own and can learn software and hardware skills.	P3	5
4	DESCRIBE the basic circuits design skills necessary for upgrading biomedical engineering knowledge	C2	12

REMARKS (if any):

Recommended by: _____

(Chairperson/Date)

Approved by: _____

(Dean/Date)

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Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **BM-209 Basic Electronics**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Solid State Theory:

Atomic structure of elements; energy band diagram for solids; intrinsic and extrinsic semi-conductors; electron hole pairs; distribution of electrons and holes in a semi-conductor.

Network Theorems:

Voltage and current sources Voltage Divider Rule, Current Divider Rule, Kirchhoff Current Law, Kirchhoff Voltage Law, Thevenin's and Norton's Theorem.

Diode & Its Applications:

Diode; PN junction diode; forward; reverse characteristics of a diode. Ideal diode; practical diode; equivalent circuit of a diode; current equation of a diode; diode as a switch; diode as a rectifier; diode as clipper; diode as clamper; diode in gating circuits; breakdown diodes; voltage regulator.

Transistor (BJTS):

Junction transistors; construction and operation; static characteristic; transistors configurations; DC biasing of a transistor; types of biasing; biasing techniques; DC circuit analysis; load line; operating point and bias stabilization; transistor as amplifier; small signal operation.

FETS:

Introduction to field effect transistor; JFETS and MOSETS.

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	RECALL the functions and symbols of electronics components	C1	1
2	DESCRIBE the basic construction and operation of electronic circuits by utilizing working mechanism of electrical components	C2	2
3	EXERCISE prototyping various electronic circuits by utilizing modern tools	P2	5
4	COMMIT to working with others for circuit designing through oral discussion	A3	9

REMARKS (if any):

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Approved by: _____ (Dean/Date)

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Course Profile

COURSE CODE& TITLE **BM-222 Engineering Mechanics for Biomedical Engineers**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Introduction:

General principles; units of measurement.

Force Vectors:

Addition of vectors; Cartesian vectors; free vector; position vectors; force directed along a line.

Equilibrium of a Particle:

Conditions for the equilibrium; free body diagram; 3D force systems; force system resultants; moment of force; Virognon's theorem; cross product; moment of a couple; equivalent systems.

Equilibrium of a Rigid Body:

Equilibrium in 2D and 3D; constrains for a rigid body; redundant and improper constraints.

Friction:

Types of friction; angle of repose; application of friction.

Kinematics of a Particle:

Rectilinear motion; curvilinear motion; motion of projectile; absolute dependent motion of two particles.

Kinetics of a Particle:

Equation of motion for a system of particle; equation of motion in rectangular, cylindrical, normal and tangential coordinates; principles of work and energy for a system of particles; linear momentum; conservation of momentum; impact; angular momentum; kinematics of a rigid body; translation; rotation.

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	Ability to DESCRIBE various theoretical concepts related to engineering mechanics.	C2	1
2	Ability to SOLVE numerical problems related to statics and dynamics by determining which concepts apply and choosing an appropriate solution strategy.	C3	2
3	Ability to INVESTIGATE real-life engineering mechanics problems in a methodical way.	C3	4

REMARKS (if any):

Recommended by: _____

(Chairperson/Date)

Approved by: _____

(Dean/Date)

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Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **BM-230 Biochemistry**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

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.

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.

Bioenergetics:

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

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.

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.

Nitrogen Metabolism:

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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.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	ACQUIRE knowledge of biochemical and biophysical processes at molecular level and be able to EXPLAIN the structure, classification and function of basic elements present inside the body, with central dogma of molecular biology and other models.	C1	1
2	ANALYZE metabolic pathways and activity of biomolecules at cellular level.	C3	4
3	DESCRIBE the ethical concerns pertaining to diagnostic testing for research and medical purposes	P3	8

REMARKS (if any):

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Approved by: _____ (Dean/Date)

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Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **BM-306 Bioinstrumentation and Measurements – I**	SEMESTER **□ SPRING ■ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **BM-209 Basic Electronics**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

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 & 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.

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	EXPLAIN the basic concepts related to the classification techniques and working principles of biomedical equipment.	C2	1
2	CONCEPTUALIZE the design of biomedical solutions using sensors, transducers, and biopotentials while assuming responsibility to work effectively as a team member.	A4	9
3	CONSTRUCT operational prototypes using fundamental components and software tools for various biomedical applications.	P3	3
4	DEMONSTRATE an ability to apply project management skill in developing engineering solutions for different medical issues.	C5	11

REMARKS (if any):

Recommended by: _____ **Approved by: _____**

(Chairperson/Date) (Dean/Date)

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F/QSP 11/17/01

Course Profile

COURSE CODE& TITLE **BM-307 Bioinformatics**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **BM-230 Biochemistry**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Review

Molecular biology and genetics. Introduction to Biological Databases

Introduction to bioinformatics; goals; scope and applications; types of characteristics of databases; information retrieval system.

Sequence Alignment

Why align sequence? evolutionary basis; sequence homology; similarity and identity; database similarity searching; heuristic approach; FASTA and BLAST; multiple sequence alignment; scoring function; various algorithm; Markov and Hidden Markov models; protein motif and domain prediction.

Gene and Promoter Predication

Gene predication in prokaryotes and eukaryotes; promoters and regulatory elements and prediction in prokaryotes and eukaryotes; predication algorithms.

Molecular Phylogenetic

Molecular evolution and molecular phylogenetic; gene and species phylogeny; tree representation.

Structural Bioinformatics

Protein structure basics; protein structure visualization; comparison and classification; secondary and tertiary; quaternary structures; RNA structure prediction.

Genomics and Proteomics

Genome mapping; sequencing; assembly annotation and comparison; functional genomics; sequence-based approaches; micro array bases approaches; protein expression analysis; protein sorting; protein-protein interaction.

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	EXPLAIN concepts and processes of biology, computer science and mathematics in relation to the context of cellular and molecular biology and genomics research	C2	1
2	EXPLAIN methods that can be used to solve environmental issues using microbial genome applications, gene therapy and biotechnology.	C2	7
3	ANALYZE biological data for investigation of novel genomic regions	C4	4

REMARKS (if any):

Recommended by: _____

(Chairperson/Date)

Approved by: _____

(Dean/Date)

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Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **BM-310 Control Systems for Biomedical Engineers**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **EE-217 Circuit Theory**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Introduction

A History of Control Systems; System Configurations; Analysis and Design Objectives; The Design Process; Control Systems Engineer.

Modeling in the Frequency Domain

Laplace Transform Review; The Transfer Function; Electrical Network Transfer Functions; Mechanical System Transfer Functions; Electromechanical System Transfer Functions; Nonlinearities; Linearization.

Modeling in the Time Domain

General State-Space Representation; Applying the State-Space Representation; Converting a Transfer Function to State Space; Converting from State Space to a Transfer Function; Linearization.

Time Response

Poles, Zeros, and System Response; First-Order Systems; Second-Order Systems; Underdamped Second-Order Systems; System Response with Additional Poles; System Response with Zeros; Effects of Nonlinearities Upon Time Response.

Reduction of Multiple Subsystems

Block Diagrams; Signal-Flow Graphs; Mason's Rule.

Stability

Routh-Hurwitz Criterion; Routh-Hurwitz Criterion Special Cases; Stability in State Space

Steady-State Errors

Steady-State Error for Unity Feedback Systems; Static Error Constants and System Type; Steady- State Error Specifications; Steady-State Error for Disturbances; Sensitivity.

Root Locus Techniques

Root Locus; Properties of the Root Locus; Sketching the Root Locus; Refining the Sketch; Transient Response Design via Gain Adjustment; Generalized Root Locus; Root Locus for Positive-Feedback Systems; Pole Sensitivity

Design Via Root Locus

Improving Steady-State Error via Cascade Compensation; Improving Transient Response via Cascade Compensation; Improving Steady-State Error and Transient Response; Feedback Compensation.

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Frequency Response Techniques

Asymptotic Approximations Bode Plots; Nyquist Criterion; Sketching the Nyquist Diagram; Stability via the Nyquist Diagram; Gain Margin and Phase Margin via the Nyquist Diagram; Stability, Gain Margin, and Phase Margin via Bode Plots; Relation Between Closed-Loop Transient and Closed-Loop Frequency Responses.

Design Via Frequency Response

Transient Response via Gain Adjustment; Lag Compensation; Lead Compensation; Lag-Lead Compensation

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	UNDERSTAND and DESCRIBE the basic principles of control engineering and designing of control systems.	C2	1
2	ILLUSTRATE models of control systems through transfer functions, block diagrams and state spaces.	C3	2
3	ANALYZE a model through investigation of its performance and analysis of its response, errors, and stability.	C5	4
4	Design a control system, analyze the system response and DEMONSTRATE its performance using modern tools.	P2	9

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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F/QSP 11/17/01

Course Profile

COURSE CODE& TITLE **BM-311 Bioinstrumentation & Measurements-II**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **BM-209 Basic Electronics**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

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

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	IDENTIFY a range of components, relevant sensors, and used in particular application including Chromatography, spectroscopy, microscopy, Centrifuge machine, and chemistry analyzers	C1	1
2	ILLUSTRATE the use of different electronic circuits, software tools, and concept of applied sciences required for the design of biomedical applications.	C2	3
3	DEMONSTRATE the working of various medical equipment, their safety requirements, and risks associated with them to patients.	P2	6
4	UNDERSTAND the complexity of medical instruments and learn the sustainable solution for effective health care delivery.	A4	7

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **BM-312 Biostatistics**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Overview:

Biostatistics; types of data and data representation; descriptive statistics; measures of central tendencies; measures of dispersion; Chebyshev's inequality.

Probability Concepts:

Permutation and combination; elementary properties of statistics; conditional probability; Bayes' theorem.

Diagnostics Tests:

Sensitivity and specificity; ROC curve; prevalence; relative risk; odds ratio; life table; rates and standardization (vital statistics).

Probability Distributions:

Binomial distribution; Poisson distribution; normal distribution.

Sampling Distribution of Mean:

Sampling distribution; central limit theorem and its application.

Estimation (or Confidence Interval):

One-sided and two-sided confidence interval; student's t distribution.

Hypothesis Testing:

Tests of hypothesis; types of error; power; sample size estimation.

Comparison of Two Means:

Paired samples; independent samples; correlation.

Linear Regression:

Models and their evaluation.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	UNDERSTAND and EXPLAIN the concepts of Descriptive statistics for life sciences by looking into vital statistics and demographic data	C2	1
2	DESCRIBE the concepts of probability distributions, sampling and, estimation to PREPARE and verify Hypotheses through testing.	C2	2
3	CONDUCT statistical tests and use contextual knowledge to infer meaningful outcomes from the data that can guide towards possible solutions to public health or society.	P3	6
4	COMBINE computational tools to organize information from a variety of sources and carry out statistical analysis to answer intended research question.	C3	12

REMARKS (if any):

Recommended by: _____ **Approved by: _____**

(Chairperson/Date) (Dean/Date)

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Course Profile

COURSE CODE& TITLE **BM-313 Biomaterials**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

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.

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	DEFINE the fundamental concepts and principles of biomaterials, their types and structures, characteristics of biomaterials, material fabrication techniques and their testing	C1	1
2	ANALYSE material type based on their performance curves (stress vs strain, phase diagram) and provide solutions for existing problems associated with biomaterials.	C2	3
3	APPLY knowledge from basic concepts of materials to propose a solution using sustainable or degradable materials for better environmental impact.	C3	7
4	USE MODERN TOOLS for characterization of biomaterials	P1	5

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

COURSE CODE& TITLE **BM-401 Numerical Methods for Biomedical Engineers**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

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 non-homogenous 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.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	DEMONSTRATE understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise	C3	1

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	intractable mathematical problems in life sciences		
2	ANALYZE and EVALUATE the accuracy of common numerical methods.	C4	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	C3	4

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

COURSE CODE& TITLE **BM-404 Biomechanics**	SEMESTER ■ SPRING □ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **BM-222 Engineering Mechanics for Biomedical Engineers**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Introduction to Biomechanics

Definition and perspective; problem solving approach.

Kinematic Concepts for Analyzing Human Motion

Forms of motion; standard reference terminology; joint movement terminology spatial reference systems; qualitative analysis of human movement; tools for measuring kinetic quantities.

Kinetic Concepts for Analyzing Human Motion

Basic concepts related to kinetics; mechanical loads on the human body; the effects of loading; tools for measuring kinematic quantities.

The Biomechanics of Human Bone Growth and Development

Composition and structure of bone tissue; material constituents; structural organization; types of bones; bone growth and development; bone response to stress; osteoporosis.

The Biomechanics of Human Skeletal Articulations

Joint architecture, stability, and flexibility; common joint injuries and pathologies.

The Biomechanics of Human Skeletal Muscle

Behavioral properties of the musculotendinous unit; structural organization of skeletal muscle and its function; muscular force, strength, power, and endurance; common muscle injuries.

The Biomechanics of the Human Upper Extremity

Structure, movement and loads of shoulder, elbow and wrist, common injuries of upper limb.

The Biomechanics of the Human Lower Extremity

Structure, movement and loads of hip, knee, ankle, and foot, common injuries of lower limb.

The Biomechanics of the Human Spine

Structure, movement and loading of spine; common injuries of back and neck.

Linear and Angular Movement

Kinetics of human movement; equilibrium and human movement; clinical gait analysis.

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	DESCRIBE gross human movements using anatomical terminology and APPLY the basic concepts of mechanics to the study of human movement.	C3	1
2	UTILIZE the common experimental methods of biomechanics, with particular emphasis on movement.	P2	2
3	ASSESS the consequences of changes in movement patterns and techniques on the human performance for daily life activities, clinical, and biomechanical research applications.	C3	6

REMARKS (if any):

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COURSE CODE& TITLE **BM-406 Biomedical Imaging**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

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 bio-effects 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.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	EXPLAIN the fundamental concepts related to radiation physics involved in biomedical imaging instruments, image reconstruction and image enhancement	C2	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.	C3	2
3	PRACTICE the steps shown for image processing in order to execute various tasks.	P3	4
4	CLASSIFY various health issues from the associated medical images and exhibit the steps of image processing techniques.	A4	6

REMARKS (if any):

Recommended by: _____ **Approved by:_____**

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Course Profile

COURSE CODE& TITLE **BM-423 Introduction to Robotics**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **BM-222 Engineering Mechanics for Biomedical Engineers**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Fundamentals of Robotics

Classification of Robots; History of Robotics; Advantages and Disadvantages of Robots; Robot Components; Degrees of Freedom; Robot Configurations; Robot Applications.

Robot Kinematics and Inverse Kinematics

Robots as Mechanisms; Homogeneous Transformation Matrices; Forward and Inverse Kinematics of Robots; Denavit-Hartenberg Representation of Forward Kinematic; Inverse Kinematic Solution of Robots; Dexterity.

Differential Motions and Velocities

Differential Relationships; Differential Motions of a Frame; Interpretation of the Differential Change; Differential Changes Between Frames; Differential Motions of a Robot and Its Hand Frame; Calculation of the Jacobian; How to Relate the Jacobian and the Differential Operator; Inverse Jacobian.

Dynamic Analysis and Forces

Lagrangian Mechanics A Short Overview; Dynamic Equations for Multiple-Degree-of-Freedom Robots; Static Force Analysis of Robots; Transformation of Forces and Moments Between Coordinate Frames.

Trajectory Planning

Path vs. Trajectory; Joint-Space vs. Cartesian-Space Descriptions; Basics of Trajectory; Joint-Space Trajectory Planning; Cartesian-Space Trajectories; Continuous Trajectory Recording.

Sensors and Actuators

Sensor Characteristics; Position Sensors; Velocity Sensors; Acceleration Sensors; Force and Pressure Sensors; Light and Infrared sensors; Touch and Tactile Sensors

Characteristics of Actuating Systems; Comparison of Actuating Systems; Hydraulic Devices; Pneumatic Devices; Electric Motors; Microprocessor Control of Electric motors; Speed Reduction.

Image Processing and Analysis with Vision Systems

Image Processing versus Image Analysis; Frequency Domain vs. Spatial Domain; Fourier Transform of a Signal and its Frequency Content; Frequency Content of an Image; Noise, Edges; Image-Processing Techniques Histogram of Images; Thresholding; Noise; Edge Detection; Hough Transform; Segmentation; Segmentation by Region Growing and Region Splitting; Image Analysis; Object Recognition by Features; Depth Measurement with Vision Systems.

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Fuzzy Logic Control

Fuzzy Control; Crisp Values vs. Fuzzy Values; Fuzzy Sets Degrees of Membership and Truth; Fuzzification; Fuzzy Inference Rule Base; Defuzzification; Applications of Fuzzy Logic in Robotics.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	DEMONSTRATE an understanding of fundamentals of robotics manipulators, sensors, actuators, and their application and USE theoretical principles/tools from robotics to describe and calculate kinematics and dynamics for robotic system (multiple DOF)	C2	1
2	PRACTICE and learn knowledge and skill through different robots and modelling software in a laboratory environment	P2	2
3	Inclination to EXPLORE the ethical concerns related to rehabilitation robotics	C2	8

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

COURSE CODE& TITLE **BM-425 Telemedicine**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Information technology and Healthcare professionals.

Overview of Telemedicine.

Communications Networks and Services.

Use of computers in distance mode of healthcare delivery; Web technology; Satellite communication systems.

Wireless communications. Basics and types of wireless networks (Bluetooth, IR, WLAN, GSM etc.). Role of Wireless technology in patient monitoring.

Body Area Network, Emergency rescue, Remote recovery, In patient Monitoring Technologies in Medical Information Processing.

Collecting data from patients; Data compression and Transfer; Capturing of medical signals; Analog to digital conversion; Bio-signal transmission and processing.

Electronic Drug Store.

Telemedicine system development and deployment IT in alternative medicines.

Future trend in Telemedicine Technology.

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	UNDERSTAND the types and forms of telemedicine, the main applications of telemedicine and telehealth and how these have evolved over time	C1	1
2	DESCRIBE the incorporation and impact of telemedicine on quality health care delivery, and with evolving telecommunication improving the patient experience.	C2	12
3	Understand the often complex legal, regulatory, accountability and reimbursement issues surrounding telehealth and RECOGNIZE the value of understanding users and contexts for effective telehealth design, and how to achieve this.	C2	6

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

COURSE CODE& TITLE **BM-427 Product Design in Biomedical Engineering**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

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.

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	LEARN the product development process for medical devices in industrial context	C1	1
2	EXPLAIN the regulatory approval process and key regulatory agencies (FDA, MDD, ISO etc.) for medical devices	C2	6
3	ESTABLISH product requirements, safety, and risk analysis, liability	C2	12

REMARKS (if any):

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Approved by: _____ (Dean/Date)

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COURSE CODE& TITLE **BM-432 Neuroscience and Neural Networks**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **BM-116 Physiology-II**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Introduction to neuroscience

Nervous system, sympathetic, parasympathetic, and motor nervous system and their functions, brain, and its functions. Neurons and glia, structure of a neuronal cell, types of glia, blood brain barriers.

Signaling in the brain

Electrical excitability of neurons, resting membrane potential, action potential. Intra neuronal singling, inter neuronal singling. Synaptic events, chemical messengers, synaptic transmission.

Receptors

Ionotropic and metabotropic receptors, signal transduction pathways, G-proteins, protein phosphorylation. Signaling to the nucleus, regulation of gene expression

Neurotransmitters

Excitatory and inhibitory amino acid neurotransmitters and functions in the brain, role of excitatory neurotransmitter in learning and memory. Diseases associated with the malfunctioning of these neurotransmitters.

Catecholamines

Functions in the brain, Diseases associated with the malfunctioning.

Artificial Neural Networks

Model of single neuron, neural network architectures. Feed forward neural networks. Multilayer perception, back propagation algorithm, radial basis function networks. Unsupervised learning. Hopfield network, self-organizing map, other unsupervised networks. Reinforcement learning

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	DISCUSS the application areas of Neuroscience require concepts of Engineering knowledge	C2	1
2	EXPLAIN the design of experiments for neuroscience by keeping the ethical considerations	C2	8
3	PERFORM analysis on data related to the field of neuroscience	P2	2

REMARKS (if any):

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Approved by: _____ (Dean/Date)

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Course Profile

COURSE CODE& TITLE **BM-451 Biosignal Processing**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **BM-306 Bioinstrumentation and Measurements – I**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Overview of Recording Techniques for Biosignals
Electrocardiogram, Electroencephalogram, Electromyogram, Functional Magnetic Resolution Imaging, Electrooculogram

Filtration of Biosignals
FIR and IIR filters on biosignals, Filters with windowing functions on biosignals

Time domain analysis methods
Concept of correlation analysis in biomedical signals, Event-related Potential in EEG/LFP, Techniques for detection of EEG and ECG rhythms, EMG signal processing

Frequency Domain analysis
Spectrum analysis, Connectivity Analysis

Time-frequency domain analysis methods
Wigner distribution, Short-time FFT, Wavelet analysis on biomedical signals

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	EXPLAIN the use of methods and techniques for recording and processing bio-signals	C2	1
2	APPLY regular processing techniques for studying differences in bio-signals to proposing sustainable solutions of problems under different conditions	C3	7
3	CONDUCT experiments on their own for recording, processing, and analyzing bio-signals	P3	2

REMARKS (if any):

Recommended by: _____ **Approved by:** _____

(Chairperson/Date) (Dean/Date)

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Course Profile

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COURSE CODE& TITLE **BM-452 Modelling & Simulation for Biomedical Engineers**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **CS-109 Computer Programming**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

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.

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
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	C2	1
2	Organize the procedures of discrete and continuous time simulations to infer meaningful insights and their impact on real-life scenarios and applications.	A4	7
3	ANALYZE Monte Carlo Simulation and Cellular Automata and be able to EXAMINE Network and Agent based models	C4	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.	P2	11

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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COURSE CODE& TITLE **CS-109 Computer Programming**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Basic Data types; Variables & Constants; Operators & Expressions; Input/ processing/output; Decision Making Control Structures; Loop Structure and their Implementations; Function and their Types; Arrays and Strings; Pointers and their Application; Structures and Union; Files and their Control; Hardware Interfacing Techniques;

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	Describe fundamentals and semantics of computer programming	C2	1
2	Apply basic programming language structures	C3	3
3	Practice computer programming using constructs of a high level language (Lab work only)	C3	5

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

COURSE CODE& TITLE **CS-113 Introduction to Computing**	SEMESTER **□ SPRING ■ FALL**	CREDIT HOURS **TH □3 □2 ■1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Number Systems; Digital logic Gates, Classification of computer systems, Structure and Organization of Computers and Computer system, Computer peripherals, Classification of software systems, Introduction, software Development Process, Levels of programming language

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	REVIEW the basics of computer hardware, software, peripherals, and networks.	C2	1
2	PRACTICE with software and hardware tools commonly used in development of computerized or computer aided applications	P2	5

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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COURSE CODE& TITLE **CS-430 Microprocessor Programming & Interfacing**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Computer Architecture, Instruction Cycle, Memory Organization , Address decoding, Memory Hierarchy, Interrupts, Bus Arbitration Schemes, programmed I/O, Interrupt-Driven I/O, Direct Memory Access; General Purpose and Special purpose Processors, Internal Registers, Internal Bus Architecture, Pin Functions, Addressing Modes, Instruction Set Architecture: (Data Transfer Instructions, Arithmetic & Logic Instructions, Branch Instructions), Assembly Programming and Testing, Assembler Directives, Macros, Procedures, Instruction Encoding, Bus Cycles, Rest Circuit, Clock Generation Circuit, Wait States, Memory Interfacing, Memory Speed Requirements, I/O Interfacing, Programmable Peripheral Interface, Programmable Interval Timer, Programmable Interrupt Controller, Microprocessor System, Design; Recent Microcontroller Architectures.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	EXPLORE internal microprocessor architecture and operations	C2	1
2	ILLUSTRATE interfacing techniques of a microprocessor with memory and I/O devices	C4	2
3	SIMULATE and PROBE Instruction Set Architecture of a representative microprocessor (Lab work only)	C3	5

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **CY-110 Applied Chemistry for Engineers**	SEMESTER **□ SPRING ■ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Gases

Kinetic Gas Equation, Vander Waal's Equation, Critical phenomenon, Liquefaction of gases, specified heat (molar heat capacity).

Properties of Solution & Liquids

Surface Tension, Viscosity, Osmosis, Osmotic Pressure, pH-Buffer solution, Spectrophotometer, Basic concepts of Colloidal Chemistry, Classification purification (dialysis).

Thermochemistry

Chemical thermodynamics, Hess's Law, Heat of reaction, Relation between H and U measurement of heat reaction, Bomb Calorimeter

Electrochemistry

Laws of Electrolysis, E.M.F. series, corrosion (Theories, inhibition & protection).

Water & Sewage

Sources of water, impurities, hardness, water softening, purification of water for potable and industrial purposes, electro dialysis, introduction to environmental pollution, main sources and effects, Sewage treatment.

Fuels

Types of fuels, classification of fossil fuels.

Metals & Alloys

Properties and general composition of metals and alloys such as Iron, Copper, Aluminum, Chromium, Zinc used in engineering field

Engineering Materials

Inorganic engineering materials: Cement, Class Organic engineering materials: Polymers, Rubbers, Plastics and Paints, Semiconductors and Dielectric materials.

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Course Profile

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	EXPLAIN the concepts of physical and engineering chemistry.	C2	1
2	SOLVE problems of water, fuels, metallurgy & electrochemistry.	C3	2
3	APPLY the concepts of engineering chemistry to industrial processes	C3	2
4	OPERATE the equipment with guidance to measure physical & chemical parameters	P3	1

REMARKS (if any)

Recommended by: _____

(Chairperson/Date)

Approved by: _____

(Dean/Date)

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Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **EE-119 Fundamentals of Electrical Engineering**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Electrical Elements and Circuits

Energy and energy transfer, Electric charge, electric current, potential difference & voltage, Electric power & energy, Electric circuits, Sources & element resistance, Ohm`s Law Inductance, Capacitance, Fundamental circuits Laws, Kirchhoff's Laws, Direct application of fundamental laws to simple resistive networks, Node voltage and loop current methods.

Steady State AC Circuits

An introduction to periodic functions, RMS or effective, Average and maximum values of current & voltage for sinusoidal signal wave forms, An introduction to phasor method of analysis, Applications of phasor methods to simple AC circuits, Power and reactive power, Maximum power conditions.

Magnetic Circuits and Transformers

Magnetic effects of electric current, Magnetic circuit concepts, Magnetization curves, Characteristics of magnetic materials, Magnetic circuits with AC excitation, Hysteresis and eddy current losses, Introduction to transformer, The ideal transformer.

Electromechanical Energy Conversion

Basic principles, Generated voltage, Electromagnetic Torque, Introduction of Magnetic Fields, Alternating current generators, Commutator action, DC machines, Direct current Generators, Electric motors, Losses and efficiency, Machine Application consideration.

Sinusoidal Steady State Analysis

Network response to sinusoidal driving functions, Complex impedance and admittance functions, Development of concept of phasors, Power consideration, Complex power, Maximum power transfer, Tuned circuits, Series and parallel RLC tuned circuits, Definition of Quality factor.

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	Ability to use KNOWLEDGE of basic electrical quantities, AC/DC circuits, analysis techniques, electrical machines and transformer.	C1	1
2	Ability to ANALYZE circuits both AC and DC for calculation of voltages, currents and power for electrical elements.	C3	2
3	Conduct experiments in laboratory in order to interpret experimental data and observe its conformance with analyzed results of the circuit.	P2	4

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

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Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **EE-217 Circuit Theory**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Matrix Analysis

Introduction and review of Matrix theory determinants and matrix inversions, Systematic formulation of network equations, Loop variable analysis, State variable analysis, formulation of state equations, source transformations Duality.

Elementary Transient Analysis

Differential and integral forms of circuit equations, Initial voltage on a capacitor, Initial current in an inductor, First – order circuits, Solution of single first order differential equations, particular and total solution of second order linear time invariant differential equations.

Elementary Time Functions

Introduction to singularity functions, The impulse functions and response, The unit step function and response, Ramp function, Exponential function & response.

Exponential Excitation and the Transformed Network

Representation of excitations by exponentials functions, Single element response, Forced response with exponential excitation, Introduction to the transformed network, Driving point impedance and admittance

Laplace Transformation

Analysis of networks by Laplace transformation, Review of Laplace transformation, Application to network analysis.

Two Port Network

Introduction, Characterization of linear time invariant two-ports by six sets of parameters, Relationship among parameter sets, Interconnection of two ports.

Networks Functions and Frequency Response

The concept of complex frequency, transform impedance and transform circuits, Network functions, One & Two ports. Poles and zeros of network functions, Restrictions on pole and zero transfer function, magnitude and phase, Complex Loci's plots from the plane phasors.

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	EXPLAIN linear circuits by using network laws and theorem	C2	1
2	ILLUSTRATE the output by examining transient response and forced response of first and second order circuits	C3	2

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **EE-493 Digital Signal Processing**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

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

Downsampling and Up sampling, Decimation and Interpolation

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	IDENTIFY constraints for discretizing continuous time signal	C1	1
2	ANALYZE discrete signals using Fourier series, Fourier transforms, and z-transform techniques and should have understanding of formulating and optimizing analysis techniques	C4	4
3	DESIGN and analyze discrete-time systems with the help of various techniques (difference equation, convolution and frequency domain techniques)	C6	3
4	PRACTICE experimental verification of the analytical and design techniques developed for discrete time signals and systems.	P3	4

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **EF-305 Engineering Economics and Management**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Introduction: Basic Concepts and principles of Economics, Micro- and Macro-economic theory, the problem of scarcity. Basic concepts of Engineering Economy, Financial effectiveness and non-monetary factors.

Economic Environment: Consumers and producer goods, Goods and services, Demand & Supply concept. Market Equilibrium, Elasticity of demand, Elasticity of Supply, Measures of Economics worth, Price, supply-demand-relationship, Revenue, Cost and profit function.

Elementary Financial Analysis: Basic accounting equation. Development and interpretation of financial statements-Income Statement, Balance Sheet and Cash Flow, Working capital management, Financial Ratio Analysis.

Time Value of Money and Financial Returns: Concepts of simple, compound and effective interest rates, less often than compounding period and more once a year; Present Value, Future Value and Annuities concepts, Uniform gradient and geometric sequence of cash flow.

Depreciation and Taxes: Depreciation concept, Economic life, Methods of depreciation, Gain (loss) on the disposal of an asset, Depreciation as a tax shield.

Basic cost concepts and Break-Even Analysis: Types of costs and cost curves; Determination of Cost/Revenues. Numerical and graphical presentations. Practical applications, BEA as a management tool for achieving financial/operational efficiency.

Linear Programming: Mathematical statement of linear programming problems, Graphical solutions, Simplex method, Duality Problems.

Business Organizations and financial Institutions: Type of ownership, single ownership, partnerships, corporation, type of stocks and joint stock companies, Banking and specialized credit institutions.

Management: Project Management; Integration of Organization Strategy with Projects, Defining the project, developing a network plan, managing risk, reducing project time, project selection and comparing alternatives techniques scheduling resources.

Introduction to Projection Management and Production Concepts: Basic production function, stages of production, returns to scales, Production lead time, Production rate, capacity, operations, planning and control, order processing, Scheduling, planning, line of balance.

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	REMEMBER ethical principles and commit to professional ethics and responsibilities and norms of engineering practice in accounting, depreciation calculations and determining time value of money following objectivity principle of accounting.	C1	8
2	IDENTIFY and ANALYZE microeconomic environment that includes goods and services, market force and equilibrium to help determine price etc.	C2	7
3	APPLY project management principles to business and economic scenarios.	C3	11

REMARKS (if any)

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Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE **HS-105 Pakistan Studies**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Historical and ideological perspective of Pakistan Movement

Two nation theory: Definition, Significance.

Creation of Pakistan: Factors leading to the creation of Pakistan, Quaid-e-Azam and the demand for Pakistan

Land of Pakistan: Geo-physical conditions, Geo-political and strategic importance of Pakistan, Natural resources, water and power

Constitutional Process: Early efforts to make a constitution-problems and issues, Constitution of 1956 and its abrogation, Constitution of 1962 and its abrogation, Constitutional and Political crisis of 1971, Constitution of 1973, Subsequent constitutional developments

Contemporary Issues in Pakistan

A brief survey of Pakistan's Economy: Agricultural and industrial development in Pakistan, Internal and external trade, Economic planning and prospects

Social issues: Literacy & education in Pakistan, State of science & technology with special reference to IT education, Pakistan society and culture**.**

Environmental issues: Hazards of atmospheric pollution, other forms of environmental degradation, their causes & solutions, Pakistan's role in preservation of nature through international conventions/efforts

Foreign Policy Relations of Pakistan with neighbours, Relations with Super powers, Relations with Muslim world.

Human Rights: Conceptual foundations of Human Rights- What are Human rights? Definition, significance and importance, Comparative analysis of Islamic and western Perspectives of Human rights. UN System for Protection of Human rights - an over-view: UN Charter, International Bill of Human Rights, Implementation mechanism. Other important international treaties and conventions - The convention on the elimination of all forms of discrimination against woman, International Convention on the rights of child (CRC), Convention against torture (CAT), Refugee Convention. Pakistan's response to Human rights at national and international level -Constitutional Provisions,

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Pakistan's obligations to international treaties and documents, Minority rights in Pakistan, Pakistan's stand on violation of Human rights in the international perspective

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	UNDERSTAND the historical and ideological perspectives of Pakistan and their implications for individuals and professionals in societal contexts	C2	6
2	EXPLAIN the strategic implications of international conventions and treaties applicable to Pakistan at the national and international level	C2	12

REMARKS (if any)

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Course Profile

COURSE CODE& TITLE **HS-111 Functional English**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Speaking and Listening

Listening actively through the use of skills and sub skills, and in a variety of situations, Speaking: Fluency and confidence building through group discussions, role plays and public speaking.

Vocabulary development

Tips / strategies in vocabulary enhancement, Practice in vocabulary development

Reading

Reading skills, Sub skills, reading strategies, Reading practice through variety of reading texts and comprehension exercises, Précis writing

Writing

Note taking: Techniques for taking notes from lectures, from books (integrated with listening & reading), Process of Writing with practice in pre-writing strategies, in revising, and in, editing for grammar, Writing well- structured and effective paragraphs, essays and letters (routine communication) using proper writing mechanics. Writing descriptions, narrations, cause and effect, compare and contrast etc.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	DEMONSTRATE effective presentation skills in academic settings	A3	10
2	COMPREHEND explicit and implicit information through reading and listening strategies.	C2	10
3	COMPOSE drafts of various academic genres using writing processes and strategies.	C6	10

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

COURSE CODE& TITLE **HS-127 Pakistan Studies for Foreigners**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Historical and ideological perspective of Pakistan Movement

Land of Pakistan:

Land & People-Strategic importance- Important beautiful sights, Natural resources.

A Brief Historical Background:

A brief Historical survey of Muslim community in the sub-continent, British rule & its impacts, Indian reaction, Two nation theory, Origin & development, Factors leading towards the demand of a separate Muslim state, Creation of Pakistan

Government & Politics in Pakistan:

Constitution of Pakistan, A brief outline, Governmental structure, Federal & Provincial, Local Government Institutions, Political History, A brief account.

Pakistan & the Muslim World:

Relations with the Muslim countries

Language and Culture:

Origins of Urdu Language, Influence of Arabic & Persian on Urdu Language & Literature, A short history of Urdu literature

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	DESCRIBE the historical, ideological, socio-economic, and political aspects of Pakistan as a nation and state.	C2	6
2	DISCUSS Pakistan's culture, issues, and challenges through appropriate actions and advocacy	C2	12

REMARKS (if any)

Recommended by: _____ **Approved by:** _____

(Chairperson/Date) (Dean/Date)

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Course Profile

COURSE CODE& TITLE **HS-200 Community Service**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 □2 □1 ■0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

The aim of the course is to engage students in community services.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	EXPRESS an interest in contributing to the community and society individually and collectively through social projects.	A3	6
2	VOLUNTEER to help make a difference to a specific group, community, or organization.	A3	12

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

COURSE CODE& TITLE **HS-202 Business Communication**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Business Communication Foundations: Definition of Business, Organization & communication; Goals, Patterns, Principles, Channels, Tools, Levels, & Qualities; (7 C's) Process of communication; Forms & functions of organizational communication; Communication barriers, Feedback and its types; Listening and understanding nonverbal communication; International and cross-cultural communication

Communication technologies and techniques: Tools for digital communication; Etiquettes and ethics of using communication technologies; Communicating in Teams; Improving your performance in teams (team communication, group dynamics, etiquette in team settings); Making your meetings more productive (preparing for meetings, leading and participating in meetings; Meeting notice; Agenda and Minutes; Meeting simulation

Business Writing: Planning audience centered business messages and applying the three-step writing process; Letter and memos (structure and elements) and practice in writing letters and memos

Three Types of Business Messages and Situations: Routine / neutral / positive / good news and goodwill messages, Negative / bad news messages, Persuasive messages

Employment Communication: Resume / CV, Job application (solicited and unsolicited)

Writing Proposals and Reports: Finding and communicating information, communicating information through visuals; Writing effective proposals; Short reports (analytical and information reports, memo and letter reports); Formal reports (structure and organization)

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Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	DEMONSTRATE effective oral communication and interpersonal skills in simulated professional and business situations.	A3	10
2	APPLY principles of effective communication in various types of business messages.	C3	10
	COMPOSE effective business messages for various purposes and audiences.	C6	10

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

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COURSE CODE& TITLE **HS-205 Islamic Studies**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Quranic Verses: Tauheed: Al–Ambiya – 22, Al–Baqarah – 163 & 164**.**

Prophet hood: Al–Imran **–** 79, Al – Huda – 7, Al–Maidah – **Here-After:** Al–Baqarah – 48, and one Hadith**. Basic Islamic Practices:** Al–Mu' minun-1-11, and two Ahadith

Amer–Bil – Ma ' Roof Wa-Nahi Anil Munkar:

The concept of Good & Evil, Importance and necessity of Da'wat-e-Deen Al-Imran – 110, Method of Da'wat-e-Deen An-Nehl-125, Al-Imran-104, and two Ahadith

Unity of the Ummah:

Al-Imran-103, Al-Hujurat-10, Al-Imran-64, Al-An' am –108, and two Ahadith .

Kasb-e-Halal:

Ta ha-81, Al- A'raf-32-33, Al-Baqarah-188, and two Ahadith**.**

Haquq-ul-Ibad:

Protection of life (Al-Maidah-32), Right to Property (Al-Nisa-29), Right to Respect & Dignity (Al-Hujurat –11-12), Freedom of Expression (Al-Baqarah-256), Equality: (Al-Hujurat-13) , Economic Security: (Al-Ma' arij – 24-25), Employment Opportunity on Merit: (An-Nisa-58), Access to Justice: (An- Nisa-135)

Women's Rights:

An-Nehl - 97, Al-Ahzab - 35, An-Nisa - 07. Relations with Non-Muslims: Al-Mumtahanah-8-9, Al-Anfa'al –61 and The last sermon of Hajj of Holy Prophet (PBUH): Relevant extracts

Seerat (life) of the Holy Prophet (PBUH):

Birth, life at Makkah, declaration of prophet hood, preaching & its difficulties, migration to Madina, brotherhood (Mawakhat)& Madina Charter, The Holy Wars of the Prophet (Ghazwat-e-Nabawi), Hujjat-ul-Wida, The last sermon of Khutbatulwida, Translation and important points

Islamic Civilization:

a) In the sub-continent: pre- Islamic civilizations. The political, social & moral impacts of Islamic civilization (b) EEin the world: academic, intellectual, social & cultural impact of Islam on the world

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	EXPLAIN the given Quranic verses and Hadiths to their tangible meaning and message.	C2	8
2	DESCRIBE the basic concepts of Shariah, the features of Seerat-un-Nabi (SAW), and the impact of Islam on our society	C2	8

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

COURSE CODE& TITLE **HS-206 Ethical Behavior**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Introduction to Ethics: Definition of Ethics**,** Definition between normative and positive science, Problem of freewill, Method of Ethics, Uses of Ethics

Ethical Theories: History of Ethics, Greek Ethics, Medieval, Modern Ethics, Basic concept of right and wrong: good and evil, Utilitarianism, hedonism, self-realization: egoism, intuitionism, rationalism, rationalism, Kant's moral Philosophy.

Ethics & Religion: The relation of Ethics to religion, Basic ethical principles of major religions: Hinduism, Judaism, Buddhism, Zoroastrianism, Christianity, and Islam.

Ethics, Society and moral theory: Ethical foundation of Rights and Duties, Applied Ethics, Society as the background of moral life, Universalism and Altruism, Theories of punishment.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	EXPLAIN the ethical teachings of the world's major religions.	C2	8
2	DESCRIBE the importance and implications of ethics on individuals and societies.	C2	8

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

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COURSE CODE& TITLE **HS-219 Professional Ethics**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Introduction to Professional & Engineering Ethics: Definitions - Ethics, Professional Ethics, Engineering Ethics, Business Ethics; Ethics & Professionalism. Need and scope of Engineering and Professional Ethics through Case Studies. Development of Engineering Ethics & Major issues in Engineering & Professional Ethics.

Moral Reasoning & Ethical Frameworks: Ethical Dilemma: Resolving Ethical dilemmas and making Moral Choices. Codes of Ethics (of local and international professional bodies). Moral Theories: Utilitarianism, Rights Ethics and Duty Ethics, Virtue Ethics Self-Realization & Self Interest. Ethical Problem Solving Techniques: Line drawing, flow Charting, Conflict Problems. Case Studies and applications.

Contemporary Professional Ethics: Professional Responsibilities. Risk and Safety as an Ethical Concern for Engineers Workplace Responsibilities and Ethics: Teamwork, confidentiality and conflicts of interest, Whistleblowing, Bribe and gift, risk and cost - benefit analyses, gender discrimination and sexual harassment. Environmental Ethics. Computer Ethics & the Internet. Honesty: Truthfulness, trustworthiness, academic and research integrity.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	DISCUSS the contemporary frameworks ofprofessional and engineering ethics in the light of ethical theories and dilemmas	C2	8
2	APPLY principles, theories, and codes ofethics in situations related to professionalpractice.	C3	8
3	VALUE professional, aspirational, and collective ethics for continual professionaldevelopment	A3	8

REMARKS (if any)

Recommended by: _____ **Approved by:** _____

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Course Profile

COURSE CODE& TITLE **MG-481 Entrepreneurship**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

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.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	EXPLAIN basic functions and importance of entrepreneurship	C2	12
2	VALUE business ethics on entrepreneurial activities.	A3	8
3	DEMONSTRATE the entrepreneurial skills to develop business plan	C3	11

REMARKS (if any)

Recommended by: _____ **Approved by:** _____

(Chairperson/Date) (Dean/Date)

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COURSE CODE& TITLE **MT-100 Introduction to Mathematics**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH ■4 □3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPT 2018**	APPLIED FROM BATCH **2021**

COURSE CONTENTS

Algebra:
Complex Numbers: Properties of complex numbers, conjugates and modulus. Geometrical representation of complex numbers a+ ib.

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

Cube Root of Unity:
Properties of cube root of unity; ω, ω2, 1+ ω + ω2 = 0, etc.

Matrices:
Properties, sum, difference and multiplication of matrices. Cramer's rule, solution of linear equations of three unknowns.

Determinants:
Properties, addition, subtraction and multiplication of determinants, sequence and series, arithmetic progression, standard forms of an A. P.; arithmetic means. Geometric progression, standard forms of a G. P., sum of Infinite geometric series, geometric means. Harmonic progression, Harmonic means. Relation between H.M., A.M. and G.M.

Permutation and Combination:
Recognition between permutation and combination cases, factorial n!, 0! =1 etc.

Binomial Expansion:
Expansion of type for positive integer of 'n'. Use of the general term and determine the middle term or terms of the expansion.

Partial Fractions:
Resolve into partial fractions, proper fraction, improper fraction, when all factors of denominator are linear but some are repeated. When denominator has repeated irreducible quadratic factors.

Functions:
One-one function, onto function, even function, odd function, exponential function, trigonometric function and logarithmic function.

Circular Measure:
Understand the definition of radians and use the relationship between radians and degrees.

Trigonometric Functions:
Basic functions e.g. sine, cosine, tangent etc. relation between them. Trigonometric identities, sum and difference formulae, multiple angle formulae. Express type {a(sinθ) + b (cosθ)} into Rsin(θ + φ) etc. Inverse functions.

Differential Calculus:
Limits: Basic concepts; limit of form {(sin θ)/ θ} = I; when θ tends to zero. Exponent functions and type a^x etc.

Differentiation:

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Differentiation of n product and quotient formula, trigonometric functions, exponents and logarithmic functions. Differentiation of implicit function, parametric function. Higher order Derivatives. Applications of differentiations, minima and maxima, tangent and normal, velocity and acceleration, rate of reaction etc.

Integral Calculus:

Basic Integration: Integrals of sum of powers of ", trigonometric functions, exponent functions and logarithmic functions.

Integration by parts: e.g sin, e and log etc.

Substitution method; understanding of integration form {f()/f()} and [f()]n f () etc. Standard forms, definite Integrals, Trapezium rule and Simpson's rule.

Application of integration: Area, volume, velocity and acceleration.

Coordinate Geometry:

Lines: Find length, mid-point, gradient of line segment, given the coordinates of end points. Different forms of equation of a line. Angle between two lines, distance of a point from a line.

Conic Sections:

Circle: Equation of a circle using radius and coordinate of center. Tangents and normal.

Parabola: Equation of parabola, focus, vertex, directrix and intersection of parabola.

Ellipse: Equation of ellipse, eccentricity, foci, latus rectum, major and minor axes.

Hyperbola: Equation of hyperbola, foci, directrices, eccentricity and latus rectum etc.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	IDENTIFY functions and sketch their graphs using tools of calculus in relevant engineering problems.	C1	1
2	DISCUSS the concept of differential and integral calculus.	C2	2
3	DESCRIBE counting techniques and binomial theorem.	C2	2

REMARKS (if any)

Recommended by: _____ **Approved by:** _____

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COURSE CODE& TITLE **MT-114 Calculus**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Set and Functions: Define rational, irrational and real numbers; rounding off a numerical value to specified number of decimal places or significant figures; solving quadratic and rational inequalities in involving modulus with graphical representation; Definition of set, set operations, Venn diagrams, DeMorgan s laws, Cartesian product, Relation, Function and their types (Absolute value, greatest integer and combining functions). Graph of some well- known functions. Limit of functions and continuous and discontinuous functions with graphical representation.

Propositional Logic: Definition of Proposition, Statement and Argument, Logical Operators, Simple and Compound proposition, various types of connectives, Truth table, tautology, Contradiction, Contingency & Logical equivalence.

Boolean Algebra: Definition, Boolean function, duality, some basic theorems & their proofs, two valued Boolean algebra, Truth functions, Canonical sum of product form, Digital logic Gates & Switching circuit designs.

Complex Number: Argand diagram, De Moivre formula, root of polynomial equations, curve and regions in the complex plane, standard functions and their inverses (exponential, circular and Hyperbolic functions).

Differential Calculus: Differentiation and Successive differentiation and its application, Leibnitz theorem, Taylor and Maclaurin theorems with remainders in Cauchy and Lagrange form, power series, Taylor and Maclaurin series, L Hopitals rule, extreme values of a function of one variable using first and second derivative test, asymptotes of a function, curvature and radius of curvature of a curve, partial differentiation, exact differential and its application in computing errors, extreme values of a function of two variables with and without constraints, Solution of nonlinear equation using Newton Raphson method.

Integral Calculus: Indefinite integrals and their computational techniques, reduction formulae, definite integrals and their convergence, Beta and Gamma functions and their identities, applications of integration, Centre of pressure and depth of centre of pressure.

Solid Geometry: Coordinate Systems in three dimensions, Direction cosines and ratios, vector equation of a straight line, plane and sphere, Curve tracing of a function of two and three variables, Surfaces of revolutions, transformations (Cartesian to polar & cylindrical).

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	IDENTIFY functions and define real and complex numbers	C1	1
2	APPLY differential and integral calculus to engineering problems	C3	2
3	DISCUSS the behavior of sequence and series	C3	2

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

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Course Profile

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COURSE CODE& TITLE **MT-223 Ordinary Differential Equations & Fourier Series**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

First Order Differential Equations: Basic concept; Formation of differential equations and solution of differential equations by direct integration and by separating the variables; Homogeneous equations and equations reducible to homogeneous from; Linear differential equations of the order and equations reducible to the linear from; Bernoulli's equations and orthogonal trajectories; Application in relevant Engineering.

Second and Higher Orders Differential Equations: Special types of 2nd order differential equations with constant coefficients and their solutions; The operator D; Inverse operator 1/D; Solution of differential by operator D methods; Special cases, Cauchy;s differential equations; Simultaneous differential equations; simple application of differential equations in relevant Engineering.

Partial Differential Equation: Basic concepts and formation of partial differential equations; Linear homogeneous partial differential equations and relations to ordinary differential equations; Solution of first order linear and special types of second and higher order differential equations; D' Alembert's solution of the wave equation and two-dimensional wave equations; Lagrange's solution; various Standard forms.

Laplace Integral & Transformation: Definition, Laplace transforms of some elementary functions, first translation or shifting theorem, second translation or shifting theorem, change of scale property, Laplace transform of the nth order derivative, initial and final value theorem Laplace transform of integrals. Laplace transform of functions t F(t) and F(t)/ t, Laplace transform and inverse transforms, convolution theorem, solutions of ordinary differential using Laplace transform.

Fourier series: Periodic functions and expansion of periodic functions in Fourier series and Fourier coefficients; Expansion of function with arbitrary periods. Odd and even function and their Fourier series; Half range expansions of Fourier series, "DFT and FFT, Fourier Spectrum".

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	DESCRIBE formation of differential equations to explain physical situations	C2	1
2	APPLY appropriate methods to solve differential equations of relevant engineering problems	C3	2

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

COURSE CODE& TITLE MT-272 Linear Algebra & Geometry	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) None	DATE OF COURSE CONTENT APPROVAL 18 SEPT 2018	APPLIED FROM BATCH 2021

COURSE CONTENTS

Linear Algebra: Linearity and linear dependence of vectors, basis, dimension of a vector space, field matrix and type of matrices (singular, non- singular, symmetric, non- symmetric, upper, lower, diagonal tri-diagonal matrix), Rank of a matrix using row operations and special method, echelon and reduced echelon forms of a matrix, determination of consistency of a system of linear equation using rank, transitions matrix.

Euclidean Spaces and Transformation: Geometric representation of vector, norm of vector, Euclidean inner product, projections and orthogonal projections, Euclidean n spaces n properties Cauchy-Schwarz inequality, Euclidean transformations, apply geometric transformations to plane figure, composition of transformations.

Application of linear Algebra: Leontief Economic models, Electrical Networks, Scaling, translation, rotation, and projection etc.

Eigen values & Eigen Spaces: Interpret eigenvectors and eigenvalues of a matrix in terms of transformation it represents, convert a transformation into a matrix eigen value problem, find the eigenvalues and eigenvectors of order not more than 3×3 matrices algebraically, determine the modal matrix for a given matrix, reduce a matrix to diagonal (form and Jordan form, state the Cayley-Hamilton theorem and use it to find powers and the inverse of a matrix, understand a simple numerical method for finding the eigenvectors of a matrix, use appropriate software to compute the eigenvalues and eigenvectors of a matrix, Define quadratic form and determine its nature using eigenvalues.

Solid Geometry: Coordinate Systems in three dimensions. Direction cosines and ratios, vector equation of a straight line, plane and sphere, curve tracing of a function of two and three variables, Surfaces of revolutions. Transformations (Cartesian to polar & cylindrical)

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	DESCRIBE formation of system of linear equations and solid geometry to explain physical situations	C2	1
2	APPLY appropriate methods to solve system of linear equations in relevant engineering problems	C3	2

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

COURSE CODE& TITLE **PH-127 Applied Physics for Engineers**	SEMESTER **□ SPRING ■ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Introduction and Properties of Matter and Fluids

Introduction of Engineering Physics, Elasticity, and modulus of elasticity, Bending of beams, Cantilever, Steady and turbulent flow, Bernoulli`s theorem and Viscosity, Surface tension, Surface energy and Angle of contact.

Heat and Thermodynamics

Heat, temperature and theories of heat, Adiabatic and isothermal processes and the four laws of thermodynamics

Thermodynamic functions, Efficiency of heat engines, Carnot`s cycle, Entropy. Reversible process and cycles, Thermodynamic equilibrium, Introduction to heat transfer mechanisms.

Waves and Optics

Waves and oscillations, Simple harmonic motion, Types of wave motion. Optics of light, Interference, Diffraction, Polarization. Double refraction, Dispersion, Types and uses of deviation lasers.

Electricity and Magnetism

Electric charges, Electric field, Electric potential, Coulomb`s law, Gauss`s law, Capacitors and dielectrics, Magnetic field, Magnetic force on current, Ampere`s law, Faraday`s law, and Lenz`s law, Electric current, Ohm`s law, Magnetic properties of matter

Sound waves

Speed of sound, Different types of sound waves.

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	DISCUSS principle of physics; and explain the concept of classical physics to solve related problems	C1	1
2	USE the concept of physics for engineering problems	C3	2
3	PRACTICE of operating equipment/tools to understand principles of physics under supervision.	P3	1

REMARKS (if any)

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

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COURSE CODE& TITLE **TC-201 Digital Logic Design**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPT 2018**	**APPLIED FROM BATCH** **2021**

COURSE CONTENTS

Computer Operations: Evaluation of the computer, basic organization of digital computer, instruction formats, some different types of computers, special purpose and general purpose computers.

Number Systems: Conversion between bases, arithmetic with bases other than ten, negative numbers, binary coded decimal numbers, octal and hexadecimal number systems.

Truth Function: Binary connectives, evaluation of truth functions, many statement compounds, physical realisations, sufficient sets of connectives, digital computer examples.

Boolean Algebra: Truth functional calculus as Boolean algebra, duality, fundamental theorems of Boolean algebra, examples of Boolean simplifications, remarks on Switching functions.

Minimizations of Boolean Functions: Standard forms of Boolean functions, Minterm and maxterm, Designation of Boolean functions, Karnaugh map representation of Boolean functions, simplification of functions on Karnaugh maps, map minimisation of product of sums expressions, incompletely specified functions.

Tabular Minimization: Cubical representation of Boolean functions, Determination of prime implicants, Selection of an optimum set of prime implicants, Design of NAND and NOR Networks and properties of combinational network, Introduction to design of NAND and NOR Networks, Switching expressions for NAND and NOR Networks, Transient response of combination Networks.

Introduction to sequential Networks: Latches, Sequential Networks in fundamental mode, Introduction to the Synthesis of Sequential Networks, Minimisation of the number of states, Clocked Networks.

Introduction to Verilog-HDL and VHDL: Coding description of Combinational and sequential circuits.

Switching Devices: Switches and relays logic circuits, speed and delays in logic circuits, integrated logic circuits.

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	Able to perform BASICS of number conversion in different bases and also able to perform arithmetic on different bases.	C2	1
2	DESIGN and analyze combinational and sequential digital circuits.	C4	3
3	Use of computer aided tool and discrete component to design and INVESTIGATE digital circuits	P3	4

REMARKS (if any)

Recommended by: _____

(Chairperson/Date)

Approved by: _____

(Dean/Date)