KIT - Kalaignarkarunanidhi Institute of Technology

An Autonomous Institution

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NAAC with 'A' GRADE & NBA (AERO, CSE, ECE, EEE, MECH & MBA)

An ISO 9001 : 2015 Certified Institution, Coimbatore - 641 402.

Regulations, Curriculum & Syllabus - 2023

(For Students admitted from the Academic Year 2023-24 and onwards)

BACHELOR OF ENGINEERING DEGREE
IN
BIOMEDICAL ENGINEERING

Department of Biomedical Engineering

Vision and Mission of the Department

Vision	
+	To be a renowned centre in offering Biomedical Engineering education, research and application of knowledge for the benefit of society.

Mission	
+	Provide quality education to excel in Biomedical Engineering by relating engineering and medicine.
+	Impart fundamental and advanced skills to create innovative ideas in interdisciplinary fields to accomplish the technological needs of the society.
+	Develop entrepreneurship qualities to innovate new technologies for health care applications.

Program Educational Objectives (PEO's)	
PEO 1	Graduates will be successful in their professional career as an employee in India or abroad through the core foundation and knowledge acquired in engineering and medicine..
PEO 2	Graduates will have skills to identify and engage query, develop new innovations and products for needs of the society.
PEO 3	Graduates will exhibit leadership, make decisions with societal and ethical responsibilities, function and communicate effectively in multidisciplinary settings

Programme Outcomes (PO's)	
Students graduating from Biomedical Engineering should be able to:	
PO 1	**Engineering knowledge :** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis :** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design / development of solutions :** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.

PO 4	**Conduct investigations of complex problems :** Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage :** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society :** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability :** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics :** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work :** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication :** Communicate effectively 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.
PO 11	**Project management and finance :** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life–long learning :** Recognize the need for, and have the preparation and ability to engage in independent and life–long learning in the broadest context of technological change.

Program Specific Outcome (PSO's)	
Graduates of a Biomedical Engineering Programme should be able to	
PSO 1	Adapt to emerging information and communication technologies (ICT) to develop new innovations and solutions thereby developing indigenous medical instruments that are on par with the existing technology.
PSO 2	Design diagnostic and therapeutic equipments those reduce physician burnout and improve the quality of life for the end user by applying fundamentals of Biomedical Engineering.

BoS Chairman

Curriculum

KIT-Kalaignarkarunanidhi Institute of Technology
(An Autonomous Institution)
Coimbatore – 641 402.
Department of Biomedical Engineering
Conceptual Frame work
(For Students admitted from the Academic Year 2023-2024 and onwards)

Semester	Level of Course	Hours / Week	No of Courses	Range of Credits/ Courses	Total Credits
PART I					
A - Foundation Courses					
I to II	Humanities and Social Sciences **(HS)**	1-4	5	1-3	**10**
I to IV	Basic Sciences **(BS)**	4-5	5	4	**20**
I to II	Engineering Sciences **(ES)**	3-6	6	2-4	**18**
B - Professional Core Courses					
II to VII	Professional Core **(PC)**	2-4	26	2-4	**77**
C - Elective Courses					
V to VIII	Professional Elective **(PE)**	3	6	3	**18**
V to VIII	Open Elective **(OE)**	3	4	3	**12**
D – Project Work					
VI, VII & VIII	Project Work **(PW)**	4 -16	3	2 - 8	**12**
E - Mandatory Courses Prescribed by AICTE/UGC (Not to be Included for CGPA)					
I, III & IV	Mandatory Course **(MC)**	2-3	4	NC	NC
PART II					
F- Career Enhancement Courses (CEC)					
IV	Professional Certificate Course	-	-	-	**1**
V	Summer Internship	-	-	-	**1**
Total Credit					**169**

Programme Coordinator

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Curriculum and Scheme of Assessment

(For Students admitted from the Academic Year 2023-24 and onwards)

Semester - I										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23IPT101	Induction Programme	HS	-	-	-	-	NC	-	-	-
Theory / Theory with Practical										
B23ENT101	Professional English	HS	2	2	0	0	2	40	60	100
B23MAT101	Matrices and Differential Calculus	BS	4	3	1	0	4	40	60	100
B23MET101	Engineering Graphics	ES	4	2	2	0	4	40	60	100
B23HST101	தமிழர்மரபு / Heritage of Tamils	HS	1	1	0	0	1	40	60	100
B23CHI101	Engineering Chemistry	BS	5	3	0	2	4	50	50	100
B23CSI101	C Programming	ES	5	3	0	2	4	50	50	100
Practical										
B23MEP101	Engineering Practices Laboratory	ES	4	0	0	4	2	60	40	100
Total credits to be earned							21			

Semester - II										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23MAT201	Integral Calculus and Complex Analysis	BS	4	3	1	0	4	40	60	100
B23HST201	தமிழரும் தொழில்நுட்பமும்/ Tamils and Technology	HS	1	1	0	0	1	40	60	100
B23BMT201	Biosciences for Medical Engineering	PC	3	3	0	0	3	40	60	100
B23EET203	Introduction to Electrical Engineering	ES	4	3	1	0	4	40	60	100
B23ENI101	Professional Communication	HS	5	3	0	2	4	50	50	100
B23PHI101	Engineering Physics	BS	5	3	0	2	4	50	50	100
B23CEP201	Soft Skills	CEC	2	2	0	0	NC	100	-	100
B23CEP202	Application Design and Development	CEC	2	2	0	0	NC	100	-	100
Practical										
B23BMP201	Biosciences Laboratory	PC	4	0	0	4	2	60	40	100
Total credits to be earned							22			

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Semester - III										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23MAT303	Transforms and Probability	BS	4	3	1	0	4	40	60	100
B23BMT301	Sensors and Measurements	PC	3	3	0	0	3	40	60	100
B23CSI 303	Fundamentals of Data Structures using C	ES	5	3	0	2	4	50	50	100
B23BMT302	Electronic Devices and Circuits	PC	3	3	0	0	3	40	60	100
B23ECT303	Signals and Systems	PC	3	3	0	0	3	40	60	100
B23BMT303	Anatomy and Human Physiology	PC	3	3	0	0	3	40	60	100
Practical										
B23BMP301	Electronic Devices and Circuits Laboratory	PC	4	0	0	4	2	60	40	100
B23BMP302	Anatomy and Human Physiology Laboratory	PC	4	0	0	4	2	60	40	100
B23ECP303	Signals and Systems Laboratory	PC	2	0	0	2	1	60	40	100
Total credits to be earned							25			

Semester - IV										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23BMT401	Digital Circuits and Design	PC	3	3	0	0	3	40	60	100
B23BMT402	Bio Signal Processing	PC	4	3	1	0	4	40	60	100
B23BMT403	Bio Control Systems	PC	4	3	1	0	4	40	60	100
B23ECT403	Linear Integrated Circuits	PC	3	3	0	0	3	40	60	100
B23BMT404	Biomaterials	PC	3	3	0	0	3	40	60	100
B23BMT405	Biomechanics	PC	3	3	0	0	3	40	60	100
Practical										
B23BMP401	Bio Signal Processing Laboratory	PC	4	0	0	4	2	60	40	100
B23BMP402	Linear and Digital Integrated Circuits Laboratory	PC	4	0	0	4	2	60	40	100
B23CEP301	Professional Certificate Course	CEC	2	0	0	2	1	100	-	100
Total credits to be earned							25			
Summer Internship – THREE WEEKS (Review will be conducted in first week of Semester V and its credit will be included in Semester V)										

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Semester - V										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23BMT501	Biomedical Instrumentation	PC	3	3	0	0	3	40	60	100
B23BMT502	Embedded Systems	PC	3	3	0	0	3	40	60	100
B23BMT503	Internet of Things in Healthcare	PC	3	3	0	0	3	40	60	100
B23AMI 301	Object Oriented Programming using Java	PC	5	3	0	2	4	50	50	100
	Professional Elective I	PE	3	3	0	0	3	40	60	100
	Open Elective I	OE	3	3	0	0	3	40	60	100
B23MCT50X	Mandatory course I	MC	2	2	0	0	NC	100	-	100
B23MCT505	Holistic Insight into UN SDGs	MC	2	2	0	0	NC	100	-	100
Practical										
B23BMP501	Embedded Systems and IoMT Laboratory	PC	4	0	0	4	2	60	40	100
B23BMP502	Biomedical Instrumentation Laboratory	PC	4	0	0	4	2	60	40	100
B23CEP501	Summer Internship	CEC	-	-	-	-	1	100	-	100
Total credits to be earned							24			

Semester - VI										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23BMT601	Diagnostic and Therapeutic Equipment	PC	3	3	0	0	3	40	60	100
B23BMT602	Radiological Equipment	PC	3	3	0	0	3	40	60	100
B23BMT603	Rehabilitation Engineering	PC	3	3	0	0	3	40	60	100
B23BMT604	Bio MEMS	PC	3	3	0	0	3	40	60	100
	Professional Elective II	PE	3	3	0	0	3	40	60	100
	Open Elective II	OE	3	3	0	0	3	40	60	100
B23MCT60X	Mandatory course II	MC	2	2	0	0	NC	100	-	100
B23MCT605	Cyber Safety Concepts	MC	2	2	0	0	NC	100	-	100
Practical										
B23BMP601	Diagnostic and Therapeutic Equipment Laboratory	PC	4	0	0	4	2	60	40	100
B23BMP602	Innovative Design Practices	PW	4	0	0	4	2	40	60	100
Total credits to be earned							22			

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Semester - VII										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23MGT701	Universal Human Values	HS	3	3	0	0	2	40	60	100
B23BMT701	Medical Image Processing	PC	3	3	1	0	4	40	60	100
B23BMT702	Human Assist Devices	PC	3	3	0	0	3	40	60	100
	Professional Elective – IV	PE	3	3	0	0	3	40	60	100
	Professional Elective – V	PE	3	3	0	0	3	40	60	100
Practical										
B23BMP702	Medical Equipment Training	PC	6	0	0	6	3	60	40	100
B23MEP702	Project work Phase – I	PW	8	0	0	8	4	40	60	100
Total credits to be earned							22			

Semester - VIII										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Practical										
B23MEP801	Project Work Phase - II	PW	16	0	0	16	8	40	60	100
Total credits to be earned							8			

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BOS Chairman

Programme Coordinator

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Vertical 1 HEALTHCARE SYSTEMS	Vertical 2 HEALTHCARE TECHNOLOGIES	Vertical 3 COMPUTING TECHNOLOGIES	Vertical 4 HEALTHCARE TECHNOLOGY MANAGEMENT	Vertical 5 MEDICAL DEVICE INNOVATION & DEVELOPMENT	Vertical 6 SIGNAL AND IMAGE PROCESSING
Wearable Biomedical System	Clinical Care Equipment	Foundations of Operating Systems	Nano Technology	Medical Device Design	Advanced Bio Signal Processing
Body Area Network	Advanced Healthcare Technology	Information Retrieval	Assistive Technology	Emergency medical devices	Medical Image Analysis
Extended and Augmented Reality	Robotics in Medicine	Foundations of Artificial Intelligence and Machine Learning	Patient Safety Standards and Ethics	Medical Equipment Testing and Calibration	Speech and Audio Processing
Telehealth Technology and Cyber Security	Advanced Therapeutic Equipment	Foundations of Cloud Computing	Occupational Safety and HIPPA	Medical Innovation and Entrepreneurship	Radio Imaging techniques
Biometrics in Healthcare	Sports Engineering and Technology	Computer Vision	Hospital admin and Waste Management	Artificial Organs and Implants	Video Processing and Analysis
Computational Neuroscience	Cognitive Technology	Embedded Programming using C	Ergonomics in Healthcare	IPR in Healthcare Industries	Soft computing in Healthcare
Virtual Instrumentation for medical systems	Medical Technology and Evaluation	Augmented Reality and Virtual Reality	Health Informatics	Haptics	Finite Element modelling in Healthcare

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VERTICAL 1 HEALTHCARE SYSTEMS										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory										
B23BME901	Wearable Biomedical System	**PE**	3	3	0	0	**3**	40	60	100
B23BME902	Body Area Network	**PE**	3	3	0	0	**3**	40	60	100
B23BME903	Extended and Augmented Reality	**PE**	3	3	0	0	**3**	40	60	100
B23BME904	Telehealth Technology and Cyber Security	**PE**	3	3	0	0	**3**	40	60	100
B23BME905	Biometrics in Healthcare	**PE**	3	3	0	0	**3**	40	60	100
B23BME906	Computational Neuroscience	**PE**	3	3	0	0	**3**	40	60	100
B23BME907	Virtual Instrumentation for medical systems	**PE**	3	3	0	0	**3**	40	60	100

VERTICAL 2 HEALTHCARE TECHNOLOGIES										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory										
B23BME908	Clinical Care Equipment	**PE**	3	3	0	0	**3**	40	60	100
B23BME909	Advanced Healthcare Technology	**PE**	3	3	0	0	**3**	40	60	100
B23BME910	Robotics in Medicine	**PE**	3	3	0	0	**3**	40	60	100
B23BME911	Advanced Therapeutic Equipment	**PE**	3	3	0	0	**3**	40	60	100
B23BME912	Sports Engineering and Technology	**PE**	3	3	0	0	**3**	40	60	100
B23BME913	Cognitive Technology	**PE**	3	3	0	0	**3**	40	60	100
B23BME914	Medical Technology and Evaluation	**PE**	3	3	0	0	**3**	40	60	100

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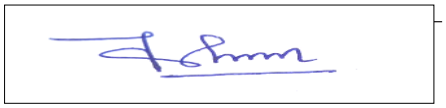
VERTICAL 3 COMPUTING TECHNOLOGIES										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory										
B23CSE926	Foundations of Operating Systems	PE	3	3	0	0	3	40	60	100
B23ADE909	Information Retrieval	PE	3	3	0	0	3	40	60	100
B23AME909	Foundations of Artificial Intelligence and Machine learning	PE	3	3	0	0	3	40	60	100
B23CSE927	Foundations of Cloud computing	PE	3	3	0	0	3	40	60	100
B23ADE914	Computer vision	PE	3	3	0	0	3	40	60	100
B23CSE925	Embedded Programming using C	PE	3	3	0	0	3	40	60	100
B23AME907	Augmented Reality and Virtual Reality	PE	3	3	0	0	3	40	60	100

VERTICAL 4 HEALTHCARE TECHNOLOGY MANAGEMENT										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory										
B23BME915	Nano Technology	PE	3	3	0	0	3	40	60	100
B23BME916	Assistive Technology	PE	3	3	0	0	3	40	60	100
B23BME917	Patient Safety Standards and Ethics	PE	3	3	0	0	3	40	60	100
B23BME918	Occupational Safety and HIPPA	PE	3	3	0	0	3	40	60	100
B23BME919	Hospital admin and Waste Management	PE	3	3	0	0	3	40	60	100
B23BME920	Ergonomics in Healthcare	PE	3	3	0	0	3	40	60	100
B23BME921	Health Informatics	PE	3	3	0	0	3	40	60	100



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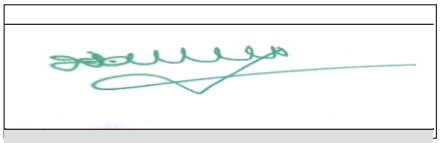

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VERTICAL 5 MEDICAL DEVICE INNOVATION & DEVELOPMENT										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory										
B23BME922	Medical Device Design	PE	3	3	0	0	3	40	60	100
B23BME923	Emergency medical devices	PE	3	3	0	0	3	40	60	100
B23BME924	Medical Equipment Testing and Calibration	PE	3	3	0	0	3	40	60	100
B23BME925	Medical Innovation and Entrepreneurship	PE	3	3	0	0	3	40	60	100
B23BME926	Artificial Organs and Implants	PE	3	3	0	0	3	40	60	100
B23BME927	IPR in Healthcare Industries	PE	3	3	0	0	3	40	60	100
B23BME928	Haptics	PE	3	3	0	0	3	40	60	100

VERTICAL 6 SIGNAL AND IMAGE PROCESSING										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory										
B23BME929	Advanced Bio Signal Processing	PE	3	3	0	0	3	40	60	100
B23BME930	Medical Image Analysis	PE	3	3	0	0	3	40	60	100
B23BME931	Speech and Audio Processing	PE	3	3	0	0	3	40	60	100
B23BME932	Radio Imaging techniques	PE	3	3	0	0	3	40	60	100
B23BME933	Video Processing and Analysis	PE	3	3	0	0	3	40	60	100
B23BME934	Soft Computing in Healthcare	PE	3	3	0	0	3	40	60	100
B23BME935	Finite Element modelling in Healthcare	PE	3	3	0	0	3	40	60	100

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HUMANITIES AND SOCIAL SCIENCES (HS)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23IPT101	Induction Programme	HS	-	-	-	-	0	-	-	-
B23ENT101	Professional English	HS	2	2	0	0	2	40	60	100
B23HST101	தமிழர்மரபு / Heritage of Tamils	HS	1	1	0	0	1	40	60	100
B23HST201	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HS	1	1	0	0	1	40	60	100
B23ENI201	Professional Communication	HS	5	3	0	2	4	50	50	100
B23MGT701	Universal Human Values	HS	3	3	0	0	2	40	60	100

BASIC SCIENCES (BS)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23MAT101	Matrices and Differential Calculus	BS	4	3	1	0	4	40	60	100
B23CHI101	Engineering Chemistry	BS	5	3	0	2	4	50	50	100
B23PHI101	Engineering Physics	BS	5	3	0	2	4	50	50	100
B23MAT201	Integral Calculus and Complex Analysis	BS	4	3	1	0	4	40	60	100
B23MAT301	Transforms and Probability	BS	4	3	1	0	4	40	60	100

ENGINEERING SCIENCES (ES)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23MET101	Engineering Graphics	ES	4	2	2	0	4	40	60	100
B23CSI101	C Programming	ES	5	3	0	2	4	50	50	100
B23MEP101	Engineering Practices Laboratory	ES	4	0	0	4	2	60	40	100
B23EET203	Introduction to Electrical Engineering	ES	4	3	1	0	4	40	60	100
B23CSI303	Fundamentals of Data Structures using C	ES	5	3	0	2	4	50	50	100
B23AMI301	Object Oriented Programming using C	ES	5	3	0	2	4	50	50	100

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PROFESSIONAL CORE (PC)

Course Code	Course Name	CT	Instructional Hours				Assessment			
			CP	L	T	P	C	CIA	ESE	Total
B23BMT201	Biosciences for Medical Engineering	**PC**	3	3	0	0	**3**	40	60	100
B23BMP201	Biosciences Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23BMT301	Sensors and Measurements	**PC**	3	3	0	0	**3**	40	60	100
B23BMT302	Electronic Devices and Circuits	**PC**	3	3	0	0	**3**	40	60	100
B23BMT303	Anatomy and Human Physiology	**PC**	3	3	0	0	**3**	60	40	100
B23ECT301	Signals and Systems	**PC**	4	3	1	0	**4**	40	60	100
B23BMP301	Electronic Devices and Circuits Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23BMP302	Anatomy and Human Physiology Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23BMT401	Bio Signal Processing	**PC**	4	3	1	0	**4**	40	60	100
B23BMT402	Bio Control Systems	**PC**	4	3	1	0	**4**	40	60	100
B23BMT401	Digital Circuits and Design	**PC**	3	3	0	0	**3**	40	60	100
B23ECT403	Linear Integrated Circuits	**PC**	3	3	0	0	**3**	40	60	100
B23BMT404	Biomaterials	**PC**	3	3	0	0	**3**	40	60	100
B23BMT405	Biomechanics	**PC**	3	3	0	0	**3**	40	60	100
B23BMP401	Bio Signal Processing Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23BMP402	Linear and Digital Integrated Circuits Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23BMT501	Biomedical Instrumentation	**PC**	3	3	0	0	**3**	40	60	100
B23BMT502	Embedded Systems	**PC**	3	3	0	0	**3**	40	60	100
B23BMT503	Internet of Things in Healthcare	**PC**	4	3	1	0	**4**	40	60	100
B23BMP501	Embedded Systems and IoMT Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23BMP502	Biomedical Instrumentation Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23BMT601	Diagnostic and Therapeutic Equipment	**PC**	3	3	0	0	**3**	40	60	100
B23BMT602	Radiological Equipment	**PC**	3	3	0	0	**3**	40	60	100
B23BMT603	Rehabilitation Engineering	**PC**	4	0	0	4	**2**	60	40	100
B23BMT604	Bio MEMS	**PC**	3	3	0	0	**3**	40	60	100
B23BMP601	Diagnostic and Therapeutic Equipment Laboratory	**PC**	4	3	1	0	**4**	40	60	100
B23BMP702	Medical Equipment Training	**PC**	4	0	0	4	**2**	60	40	100

Programme Coordinator

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PROJECT WORK (PW)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23BMP602	Mini Project	PW	4	0	0	4	2	40	60	100
B23MEP702	Project work Phase – I	PW	4	0	0	4	2	40	60	100
B23MEP801	Project Work Phase - II	PW	16	0	0	16	8	40	60	100

MANDATORY COURSE (MC)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23MCT501	Environmental Sciences	MC	3	3	0	0	NC	100	-	100
B23MCT601	Indian Constitution	MC	3	3	0	0	NC	100	-	100

CAREER ENHANCEMENT COURSE (CEC)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B19CET201	Soft Skills	CEC	2	2	0	0	NC	100	-	100
B23CEP301	Professional Certificate Course	CEC	2	0	0	2	1	100	-	100
B23CEP501	Summer Internship	CEC	-	-	-	-	1	100	-	100

HS : Humanities and Social Sciences BS
BS : Basic Sciences
ES : Engineering Sciences
PC : Professional Core
PE : Professional Elective
OE : Open Elective
CEC : Career Enhancement Courses
MC : Mandatory Courses

PW : Project Work
L : Lecture
T : Tutorial
P : Practical
C : Credit Point
CP : Contact Period
CIA : Continuous Internal Assessment
ESE : End Semester Examination

Programme Coordinator

Approved by BoS Chairman

I SEMESTER

B.E/B.Tech (Except CSBS)	B23ENT101–PROFESSIONAL ENGLISH	L	T	P	C
		2	0	0	2

Course Objectives	
1.	To develop the listening and reading skills of first year engineering and technology students.
2.	To help learners' develop vocabulary through reading skills.
3.	To enhance learners' grammatical knowledge.
4.	To enhance the learners' ability of writing different complex texts.
5.	To develop the competency of learners through LSRW skills.

UNIT-I	6
Listening: Listening to voicemail & messages; Listening and contextualizing. **Speaking:** Replying to polite requests and offers, understanding basic instructions. **Reading:** Short comprehension passages, practice in skimming & scanning **Writing:** Writing Instructions **Language development:** Parts of Speech, Wh - Questions, yes or no questions, Question tags **Vocabulary development:** Prefixes-suffixes	

UNIT-II	6
Listening: Listening commentaries and announcements **Speaking:** Role Play exercises based on workplace contexts. **Reading:** Comprehension questions including dialogues and conversations **Writing:** Writing different types of Paragraph **Language development:** Regular & Irregular Verbs, Tenses **Vocabulary development:** Understanding contextual meaning, Synonyms	

UNIT-III	6
Listening : Listening to a product launch-sensitizing leaners to the nuances of persuasive communication **Speaking :** Debate-discussion on current issues **Reading :** Short texts and longer passages-note making **Writing :** Understanding text structure, use of reference words and discourse markers, jumbled sentences **Language development:** Idioms and Phrases, Degrees of comparison **Vocabulary development:** One word substitutes	

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UNIT-IV	6
Listening : Listening to short academic videos **Speaking :** Making short presentation through short films **Reading :** Intensive and Extensive reading-reading different types of magazines **Writing :** Letter writing- formal and informal **Language development:** Direct/indirect questions **Vocabulary development:** Phrasal verbs	

UNIT-V	6
Listening : Listening to talks/lectures by specialists on specific topics **Speaking :** Discussion on general and current topics **Reading :** Longer texts-cloze reading **Writing :** Writing short essays, developing outline, identifying main and subordinate ideas, Dialogue writing **Language development:** Spelling and Punctuations, Modal verbs **Vocabulary development:** Collocations	
	Total Instructional hours:30

Course Outcomes: Students will be able to	
CO1	Develop listening and reading skills for effective communication
CO2	Develop vocabulary skills
CO3	Build grammatical understanding
CO4	Explain opinions efficiently in writing formal and informal contexts
CO5	Develop knowledge through LSRW skills

Text Books	
1.	Board of Editors Using English, “A Course book for Undergraduate Engineers and Technologists”, Orient Black Swan Limited,Hyderabad:2015
2.	Richards,C.Jack,“ Interchange StudentsBook-2”, New Delhi,CUP,2015.

Reference Books	
1.	Bailey, Stephen, “A practical guide for students”, New York Rutledge, 2011.
2.	Raman, Meenakshi and Sharma, Sangeetha “Technical Communication Principles and Practice” Oxford University Press: New Delhi, 2014.
3.	Dutt P.Kiranmai and Rajeevan Geeta, “Basic Communication Skills”, Foundation Books, 2013.

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B.E / B.Tech	B23MET101 – Engineering Graphics (Common to All)	L	T	P	C
		3	2	0	4

Course Objective:

1. Understand the conventions and method of engineering drawing.
2. Construct and interpret the basic engineering drawings.
3. Improve their visualization skills so that they can apply these skills in new product development.
4. Enhance their technical communication skill in the form of communicative drawings.
5. Comprehend the theory of projection.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 2

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT-I PLANE CURVES AND FREE HANDSKETCHING 14

Basic Geometrical constructions, Curves used in engineering practices-Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects.

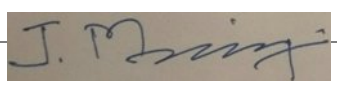
UNIT-II PROJECTION OF POINTS, LINES AND PLANE SURFACE 14

Orthographic projection- principles-Principal planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes- Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT-III PROJECTION OF SOLIDS 14

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method.

UNIT- IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 14



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Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT-V ISOMETRIC AND PERSPECTIVE PROJECTIONS 14

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-prisms, pyramids and cylinders by visual ray method.

COMPUTER AIDED DRAFTING 3

Introduction to drafting packages and demonstration of their use.

Basic Geometrical constructions using AUTOCAD.

Total Instructional Hours: 75

Course Outcome

Student will be able to

CO1: Construct the basic engineering curves and freehand sketching of basic geometrical constructions and multiple views of objects.

CO2: Draw problems related to projections of points, straight lines, planes and solids.

CO3: Build the projection of simple solids.

CO4: Apply the knowledge acquired on practical applications of sectioning and development of solids.

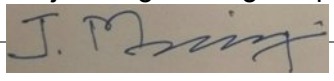
CO5: Construct simple solids and its sections in isometric view and projections and to draw its perspective views.

Text Books:

1. K.V.Natarajan, “A text book of Engineering Graphics”, 28th Edition, Dhana Lakshmi Publishers, Chennai, 2015.
2. N.D. Bhatt and V.M. Panchal, “Engineering Drawing”, Charotar Publishing House,53rd Edition, 2014.

Reference Books:

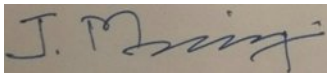
1. K. Venugopal and V.Prabhu Raja, “Engineering Graphics”, New Age International Publishers,



Approved by BoS Chairman

2017.

2. K.R.Gopalakrishna., “Engineering Drawing” (Vol. I & II combined) Subhas Publications, Bangalore, 2018.
3. N.S Parthasarathy and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015.



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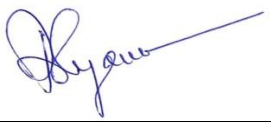
B.E / B.Tech	B23HST101 - HERITAGE OF TAMILS (Common to all Branches)	L	T	P	C
		1	0	0	1

UNIT I LANGUAGE AND LITERATURE	3
Language Families in India - Dravidian Languages – Tamil as aClassical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.	

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE	3
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.	

UNIT III FOLK AND MARTIAL ARTS	3
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.	

UNIT IV THINAI CONCEPT OF TAMILS	3
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.	



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UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	3
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.	
	Total Instructional hours : 15

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Approved by BoS Chairman

B.E / B.Tech	B23CHI101 - ENGINEERING CHEMISTRY (Common to all Branches)	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To make the students conversant with boiler feed water requirements, related problems, water treatment and inculcate practical skills in the water quality analysis.
2.	To make the students conversant with basics of polymer chemistry.
3.	To make the students conversant with basic of electrochemical reactions, corrosion and induce experimental skills in the electro-analytical techniques.
4.	To make the student acquire sound knowledge of energy devices.
5.	To develop an understanding of the basic concepts of nano materials.

UNIT – I WATER TECHNOLOGY	17
Hardness of water: Types, expression of hardness and their units, hardness problems, boiler troubles - scale and sludge, caustic embrittlement, boiler corrosion, priming and foaming. **Treatment of Boiler feed water:** Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning). **External treatment:** Ion exchange process, Zeolite process. **Desalination of brackish water:** Reverse osmosis - municipal water treatment, break point chlorination. **Determination of alkalinity in water sample, Determination of total, temporary & permanent hardness of water by EDTA method. Estimation of iron content of the water sample using spectrophotometer.**	

UNIT – II POLYMERS	9
Polymers: Definition, polymerization, types - addition and condensation polymerization, free radical mechanism - tacticity – biodegradable polymer (PHBV) and conducting polymer (poly-aniline). **Plastics:** Classification, preparation, properties and uses of PVC, teflon, nylon-6, 6 and epoxy resin. **Rubber:** Vulcanization of rubber, synthetic rubbers -n-butyl rubber and SBR.	

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Moulding: Ingredients - compression and Injection.

UNIT – III ELECTROCHEMISTRY AND CORROSION	16

Electrochemistry: Redox reaction, electrode potential - oxidation potential, reduction potential, Nernst equation (derivation) - measurement and applications - electrochemical series and its significance.

Corrosion: causes - types-chemical and electrochemical corrosion (galvanic and differential aeration), corrosion control - electrochemical protection (sacrificial anodic method and impressed current cathodic method).

Estimation of iron content of the given solution using potentiometer, Conductometric titration of strong acid vs strong base, Estimation of copper in brass.

UNIT – IV ENERGY DEVICES	9

Batteries: Types of batteries – primary (alkaline battery) and secondary battery (lead acid battery, lithium-ion-battery), Fuel Cells (H_2 - O_2 fuel cell).

Super Capacitors: Principle, construction, working and applications.

Photo voltaic cell: Solar cells - principle, construction, working and applications.

UNIT – V NANOCHEMISTRY	9

Basics: Distinction between molecules, nanoparticles and bulk materials- surface area to volume ratio.

Synthesis: Top-down process (ball milling) - Bottom-up process (chemical vapour deposition and sol-gel method).

Properties of nano materials - Optical, electrical, thermal and mechanical.

Applications of nano materials – Medicine, Industries, electronics and biomaterials.

	Total Instructional hours: 60

Course Outcomes: Students will be able to	
CO1	Determine the characterization of water and quantitative analysis of alkalinity, hardness and Iron. (K5)

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CO2	Develop the basics of polymer chemistry. (K3)
CO3	Interpret the principles of electrochemical reactions, corrosion and estimation of copper in Alloy. (K5)
CO4	Apply the concepts of energy devices and its engineering applications. (K3)
CO5	Organize the basics of Nano chemistry and its applications. (K3)

Text Books	
1.	Dara, S S and Umare, S S, “A Textbook of Engineering Chemistry”, Chand S & Company Ltd., New Delhi, 2015.
2.	Jain, P C and Monika Jain, “Engineering Chemistry” Dhanpat Rai Publishing Company Pvt. Ltd., New Delhi, 2015
3.	Vogel’s Textbook of Quantitative Chemical Analysis, 8th edition, 2014.

Reference Books	
1.	Friedrich Emich, “Engineering Chemistry”, Scientific International Pvt. Ltd., New Delhi, 2014.
2.	Prasanta Rath, “Engineering Chemistry”, Cengage Learning India Pvt. Ltd., Delhi, 2015.
3.	Shikha Agarwal, “Engineering Chemistry - Fundamentals and Applications”, Cambridge University Press, Delhi, 2015.
4.	Charles P. Poole and Frank J. Owens, "Introduction to nanotechnology", John Wiley Sons, New Jersey, 2003.

Equipment Needed for 30 Students

1. Conductivity Meter-10
2. Potentiometer-10
3. Spectrophotometer-02
4. Electronic Balance-01

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B.E / B.Tech	B23CSI101 – C PROGRAMMING (Common to CSE(AI&ML), AI&DS, BME, ECE, EEE)	L	T	P	C
		2	0	4	4

Course Objectives	
1.	To know the basics of problem-solving techniques.
2.	To provide exposure to problem-solving through programming.
3.	To develop C programming language with conditional statements and loops.
4.	To develop modular applications in C using functions pointers and structures
5.	To do input/output and file handling in C

UNIT - I	INTRODUCTION TO PROBLEM SOLVING & COMPUTER	8

Problem Solving: Problem Solving Techniques - Logical Thinking – Step for Solving the Problems – Compare Problem Solving and Logical Thinking – Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion).

UNIT - II	BASICS OF C PROGRAMMING	10

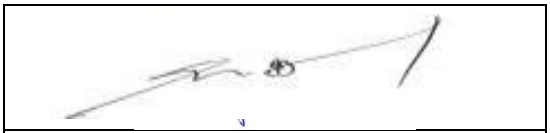
Introduction to programming paradigms - Structure of C program - Phases of developing a running computer program in C – Applications of C Language - C programming: Data Types – Storage Class - Constants – Enumeration Constants - Keywords – Operators: Operators – Types of Operators - Expressions - Precedence and Associativity – Input / Output statements – Decision making statements - Looping statements with example of Pattern – Preprocessor directives.

UNIT - III	ARRAYS AND POINTERS	9

Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays with example of Matrices Operations – Pointers: Pointer Declaration – Initialization - Pointer operators – Pointer Arithmetic – Dynamic Memory Allocation – Selection sort, Insertion sort, Bubblesort - Searching.

UNIT - IV	FUNCTION AND STRINGS	9

Function: definition of function, Declaration of function – Function Call - Prototype Declaration - Pass by value, Pass by reference – Recursion - Linear recursion, Binary Search using recursive functions - C standard functions and libraries - String operations: length, compare, concatenate, copy - String Arrays.



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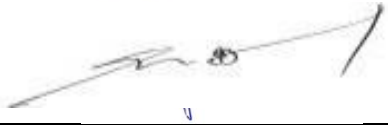
UNIT - V	STRUCTURES AND FILE HANDLING	9
Introduction: need for structure data type, structure definition, Structure declaration, Structure within a structure – Array Structure - Union – File Handling: File Operations – File Types: Sequential and Random access – Case Study: AI Processing System using C.		

Expt. No.	Description of the Experiments
1.	Experiment with I/O statements, operators, expressions
2.	Develop a C programs for Decision Making Construct. a)if-else b)switch-case c)goto, break-continue
3.	Develop a C programs for Loop Control statements. a)for b) Nested for c) while and do-while
4.	Develop a C programs for Array a)One Dimensional – Sorting and Searching b)Two Dimensional – Matrix Operations c) Traversal
5.	Develop a C program to perform the pointers. Linear Search b) Binary Search c) Pointer Operation
6.	Build a C programs for the recursive function
7.	Implement a C programs for string operations String operations using build in methods
8.	Develop a C program to experiment with Pass by value and Pass by Reference
9.	Develop a c program for structure and union a)Payroll using structure and union.b)Student records using structure and union.
10.	Develop a C program to perform file operations
	Total Instructional hours : (45+30) = 75

Course Outcomes : Students will be able to	
CO1	Demonstrate knowledge on C programming constructs
CO2	Construct C programs using decision making and control statements.
CO3	Experiment with programs in C using an array.
CO4	Build programs in C using strings, pointers, functions.



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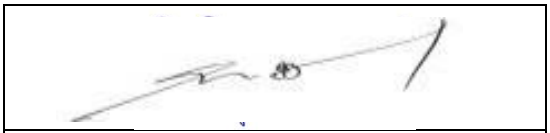
CO5	Model the applications in C using Structures, Union and File Operations

Requirements for a Batch of 30 Students		
Sl. No.	**Description of the Equipment**	**Quantity required (Nos.)**
1.	HP Make, Core i5, 11th Generation, 16GB RAM PCs, Operating systems: Windows* 10 or later, macOS, and Linux. Turbo C/C++ 4.5	30

Text Books	
1.	Yashavant P. Kanetkar. “Let Us C”, 19th Edition, BPB Publications, 2022
2.	H. M. Deitel, P. J. Deitel, C: How to program, 9th edition, Pearson Education, 2020.

Reference Books	
1.	Reema Thareja, “Programming in C”, Oxford University Press, Second Edition, 2016
2.	Kernighan, B.W and Ritchie, D.M, “The C Programming language”, Second Edition, Pearson Education, 2015
3.	Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, 1st Edition, Pearson Education, 2013
4.	Pradip Dey, Manas Ghosh, “Computer Fundamentals and Programming in C”, Second Edition, Oxford University Press, 2013.



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B.E / B.TECH	B23MEP101 – ENGINEERING PRACTICES LABORATORY (GROUP- A & B) (COMMON TO ALL BRANCHES)	L	T	P	C
		0	0	4	2

Course Objectives:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work, Sawing, planning, making joints in wood materials used in common household wood work.

2. Wiring various electrical joints in common household electrical wire work.

3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments, Making a tray out of metal sheet using sheet metal work.

4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & MECHANICAL)

I Civil Engineering Practices 12

Plumbing Works

Making basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings.

Carpentry

Preparation of wooden joints by sawing, planning and cutting

1. Planning & Polishing operation
2. Half lap joint
3. Cross lap joint

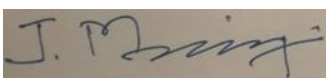
II Mechanical Engineering Practices 18

Welding Workshop

Study of welding tools and equipment's - Study of various welding methods - Instruction of BI standards and reading of welding drawings.

Exercise in arc welding for making

1. Lap joint
2. Butt joint
3. Demonstration of gas welding and cutting.



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Machine Shop

1. Drilling and Tapping
2. Lathe Exercise – Facing operation
3. Lathe Exercise – Straight turning and Chamfering

Sheet metal

Making of small parts using sheet metal

1. Making of a square tray

Demonstration

1. Demonstration on 3D Printing
2. Demonstration on Line follower robot

GROUP – B (ELECTRICAL & ELECTRONICS)

Expt. No.	Description of the Experiments	
1.	Residential house wiring using switches, fuse, indicator, lamp and energy meter.	
2.	Fluorescent lamp and Stair case wiring.	
3.	Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.	
4.	Measurement of energy using single phase energy meter.	**30**
5.	Measurement of resistance to earth of an electrical equipment.	
6.	Study of Electronic components and equipment's – Resistor color coding	
7.	Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.	
8.	Study of logic gates AND, OR, EX-OR and NOT.	
9.	Soldering & desoldering practices.	
	Total Instructional hours:	**60**

Course Outcomes:

Students will be able to

CO1: Explain the pipe connections and identify the various components used in plumbing.

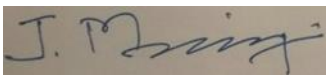
CO2: Develop simple wooden joints using wood working tools and simple components using lathe and drilling machine.

CO3: Construct simple lap, butt and tee joints using arc welding equipment and simple parts using sheet metal.

CO4: Construct Residential house wiring, Fluorescent lamp wiring and Stair case wiring.

CO5: Measure electrical quantities such as voltage, current, power & power factor in RLC Circuit, resistance to earth, AC signal parameter (peak-peak, RMS period, frequency) and ripple factor.

CO6: Examine logic gates (AND, OR, EOR and NOT), Electronic components and equipment's.



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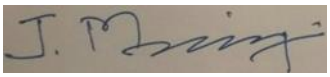
LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

GROUP – A (CIVIL & MECHANICAL)

Sl. No.	Description of Equipment	Quantity required
1	Assorted components for plumbing, Consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15
2	Carpentry vice (fitted to work bench)	15
3	Standard woodworking tools	15
4	Models of industrial trusses, door joints, furniture joints	5
	Power Tools: (a) Rotary Hammer	2
	(b) Demolition Hammer	2
5	(c) Circular Saw	2
	(d) Planer	2
	(e) Hand Drilling Machine	2
	(f) Jigsaw	2
6	Arc welding transformer with cables and holders	5
7	Welding booth with exhaust facility	5
8	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5
9	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2
10	Centre lathe	2
11	Hearth furnace, anvil and smithy tools	2
12	Moulding table, foundry tools	2
13	Power Tool: Angle Grinder	2
14	Study-purpose items: Centrifugal pump, Airconditioner	1



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GROUP – B (ELECTRICAL & ELECTRONICS)

Sl. No.	Description of Equipment	Quantity required
1.	Assorted Electrical Components for House Wiring	15 sets
2.	Electrical Measuring Instruments	10 sets
3.	Iron Box	1
4.	Fan and Regulator	1
5.	Emergency Lamp	1
6.	Megger	1
7.	Digital Live Wire Detector	2
8.	Soldering Guns	10
9.	Assorted Electronic Components for Making Circuits	50
10.	Multipurpose PCBs	10
11.	Multi Meters	10
12.	Telephone	2
13.	FM radio	2
14.	Regulated Power Supply	2
15.	CRO (30MHz)	2
16.	Bread board	10
17.	Digital IC types (IC 7432, IC 7408, IC 7400, IC 7404, IC 7402, IC 7486)	Each 10

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II SEMESTER

B.E/B.TECH	B23MAT201 INTEGRAL CALCULUS AND COMPLEX ANALYSIS (Common to all Branches)	L	T	P	C
		3	1	0	4

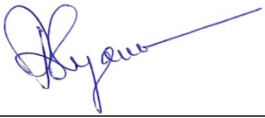
Course Objectives	
1.	To recognize various techniques of integration.
2.	To apply integration techniques in evaluating area and volume of solids.
3.	To develop the use of Vector calculus in two and three dimensional spaces.
4.	To demonstrate understanding of the basic concepts of complex differentiation.
5.	To understand Cauchy theorem and Cauchy integral formulae and apply these to evaluate complex contour integrals.

UNIT – I INTEGRAL CALCULUS	12
Riemann sum – Definite and Indefinite integrals - Substitution rule (Exponential, logarithmic, Trigonometric functions) – Integration by parts – Integration of Rational functions by Partial fraction.	

UNIT – II MULTIPLE INTEGRALS	12
Double integrals: – Double integrals in Cartesian coordinates - Double integrals in Polar coordinates – Area enclosed by plane curves – Triple integrals: Evaluation of triple integrals - Volume as triple integral (Simple problems).	

UNIT – III VECTOR CALCULUS	12
Gradient and directional derivative - Divergence and curl - Solenoidal and Irrotational vector fields - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Verification of theorem and applications (for cubes and rectangular parallellopipeds).	

UNIT – IV COMPLEX DIFFERENTIATION	12
Analytic functions - Cauchy-Riemann equations (excluding proof) – Properties of analytic function – Harmonic conjugate- Construction of analytic function by Milne Thomson method – Bilinear transformation.	



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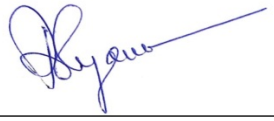
UNIT – V COMPLEX INTEGRATION	12
Cauchy's integral theorem – Cauchy's integral formula – residues - Cauchy's Residue theorem – Evaluation of real integrals – Stereographic projection – Use of circular contour and semicircular contour (excluding poles on real axis).	
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Develop Fundamental Theorem of Calculus, techniques of Integration such as substitution, partial fractions and integration by parts.
CO2	Make use of integration to compute area and volume.
CO3	Apply the line, surface and volume integrals for verification of Green's, Gauss and Stokes theorems.
CO4	Develop an understanding of the standard techniques of complex variable theory in particular analytic function
CO5	Identify contour integrations with the help of residue theorem.

Text Books	
1.	Grewal B.S.,"Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2.	Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2015.
3.	George B. Thomas , Joel Hass , Christopher Heil , Maurice D. Weir, "Thomas' Calculus", Pearson, 14th Edition, 2018.

Reference Books	
1.	Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media - An imprint of Lakshmi Publications Pvt., Ltd., New Delhi, 7th Edition, 2015.
2.	Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New



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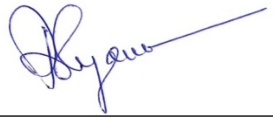
	Delhi, 5th Edition 2019.
3.	O'Neil, P.V.,"Advanced Engineering Mathematics", Cengage Learning India Pvt. Ltd, New Delhi, 7th Edition 2017.
4.	Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5.	Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics", (Tata McGraw Hill Education Pvt. Ltd), 6th Edition, New Delhi, 2012.
6.	Gean Duffy., "Advanced Engineering Mathematics with MATLAB", A CRC Press Company, Boca Raton London, New York Washington, D.C, 2nd edition 2009. (Free e- book downloaded from www.EasyEngineering.net.pdf)



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B.E / B.Tech	B23HST201- TAMILS AND TECHNOLOGY (Common to all Branches)	L	T	P	C
		1	0	0	1

UNIT I WEAVING AND CERAMIC TECHNOLOGY	3
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.	

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY	3
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.	

UNIT III MANUFACTURING TECHNOLOGY	3
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting,steel -Copper and goldCoins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.	

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY	3
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.	

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UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING	3
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.	
	Total Instructional hours : 15

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Approved by BoS Chairman

B.E / B.Tech	B23BMT201 – BIOSCIENCE FOR MEDICAL ENGINEERING	L	T	P	C
		3	2	0	4

Course Objectives	
1.	To learn about the fundamental concepts of biochemistry.
2.	To study structural and functional properties of carbohydrates, proteins, lipids and amino acids
3.	To emphasize the role of cell degeneration, repair and neoplasia.
4.	To Gain knowledge on the fluid and hemodynamic derangements.
5.	To know the fundamentals of microbiology and immunopathology.

UNIT - I	FUNDAMENTALS TO BIOCHEMISTRY	9

Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, Handerson - Hasselbalch equation, physiological buffers in living systems, Energy in living organism. Properties of water and their applications in biological systems. Introduction to Biomolecules, Biological membrane, Clinical application of Electrolytes and radioisotopes.

UNIT - II	CARBOHYDRATES, LIPIDS, PROTEINS	9

Classification of carbohydrates - mono, di, oligo and polysaccharides. Structure, physical and chemical properties of carbohydrates - Classification of lipids- simple, compound, and derived lipids. Nomenclature of fatty acid - Structure and properties of proteins, structural organization of proteins, classification and properties of amino acids. Nucleic acid: Structural aspects – Components of DNA and RNA, Nucleosides & Nucleotides (introduction, structure & bonding), Double helical structure of DNA (Watson-Crick model), various forms of DNA.

UNIT - III	CELL DEGENERATION, REPAIR AND NEOPLASIA	9

Cell injury - Reversible cell injury and Irreversible cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification- Dystrophic and Metastatic. cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours Autopsy and biopsy.

UNIT - IV	FLUID AND HEMODYNAMIC DERANGEMENTS	9

Edema, Hyperemia/Ischemia, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock and Chronic venous congestion. Hematological disorders-Bleeding disorders, Leukaemias, Lymphomas Haemorrhage.

UNIT - V	FUNDAMENTALS OF MICROBIOLOGY AND IMMUNOPATHOLOGY	9

Structure of Bacteria and Virus - Morphological features and structural organization of bacteria and virus - List of common bacterial, fungal and viral diseases of human beings.- Basics of Microscopes : Light microscope, Electron microscope (TEM & SEM). - Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediated tissue injury, Immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, monoclonal antibodies.

Total Instructional hours : 45

Course Outcomes: Students will be able to	
CO1	Explain the fundamentals of biochemistry.
CO2	Analyze structural and functional aspects of living organisms.
CO3	Identify the mechanism of disease and how events at the level of the cell affect the Patients as a whole.
CO4	Summarize the fluid and hemodynamic derangements.
CO5	Outline about the fundamentals of microbiology and immunopathology.

Text Books	
1.	RAFI MD “Text book of biochemistry for Medical Student” Fourth Edition, Universities Press,Orient Blackswan Private Limited - New Delhi 2021.
2.	Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, “Pathologic Basis of Diseases”, 10th edition: South Asia Edition Elsevier India, 2020.
3.	Ananthanarayanan & Panicker, “Microbiology” Orientblackswan, 2017, 10th edition.

Reference Books	
1.	David L.Nelson, Michael M.Cox, Lehninger “Principles of Biochemistry Macmillan”, 7th Edition 2017.
2.	Harper’s Illustrated Biochemistry, Mc Graw Hill Publishers, 30th Edition, 2018.
3.	Underwood JCE, “General and Systematic Pathology”, Churchill Livingstone, 3rd, Ed.2000.
4.	Prescott, Harley, Klein, “Microbiology”, McGraw Hill, 9th Edition, 2013.

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Approved by BoS Chairman

B.E	B23EET203 - INTRODUCTION TO ELECTRICAL ENGINEERING (BIOMEDICAL)	L	T	P	C
		3	1	0	4

Course Objectives	
1.	To introduce electric circuits and its analysis.
2.	To impart knowledge on solving circuit equations using network theorems.
3.	To address the concepts of DC Motors and Generators.
4.	To study the operation of AC machines.
5.	To gain the knowledge about the single phase and three phase transformer.

UNIT- I	DC CIRCUITS	12

DC Circuits Components: Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws – Independent and Dependent Sources – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis for DC circuits.

UNIT- II	NETWORK THEOREMS FOR DC AND AC CIRCUITS	12

Network Theorems: Super position theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem and Maximum power transfer theorem, Application to DC and AC Networks.

UNIT- III	DC GENERATORS AND MOTORS	12

Electro static field, Electric flux density, Electric field strength, Faraday's law of electromagnetic induction, Fleming's right hand rule, statically and dynamically induced EMF's. DC Machines Construction, Principles of operation, EMF and Torque equations, Types of D.C. Machines, Characteristics of DC generators, Working principle of DC motor -significance of back emf in DC motors, speed control of DC motors and applications, DC motor starters.

UNIT- IV	AC MACHINES	12

Introduction to induction machines, Rotating magnetic field, Construction and Principle of operation of three-phase induction motors, EMF equation, torque developed in an induction motor, Starting and speed control. Single phase induction motors, starting methods and applications. Special Purpose Motors: Stepper Motor, Universal Motor, shaded-pole Motor.

BoS Chairman

UNIT- V	TRANSFORMERS	12
Self and Mutual inductance, Single phase transformers: Construction, principle of working, EMF equations, KVA ratings, Voltage and Current ratios, Phasor diagrams, Losses. Definition of regulation and efficiency, Polarity test, three-phase transformer connections and instrument transformer.		
Total Instructional hours:60		

Course Out comes:	
Students will be able to	
CO1	Explain the D.C. Circuit concepts and its analysis.
CO2	Apply network theorems to solve DC and AC circuits.
CO3	Identify the concepts of DC Motors and Generators.
CO4	Outline the operation of AC machines.
CO5	Analyse the performance aspects of the single phase transformer and three phase transformer circuits.

Text Books	
1.	William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”, Tata McGraw Hill publishers, 6 th edition, New Delhi, 2003.
2.	Joseph AEdminister, Mahmood Nahri, “Electric circuits”, Schaum’s series, Tata McGraw-Hill, New Delhi, 2001.
3.	A Text Book of Electrical Technology – Vol. II, B.L. Theraja and A.K. Theraja, S.Chand Publishing, S. Chand and Company Limited, New Delhi 1998.

Reference Books	
1.	Paranjothi S R, “Electric Circuits Analysis,” New Age International Ltd., New Delhi, 1996.
2.	Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, Tata McGrawHill, 2007.
3.	Chakrabati A, “Circuits Theory (Analysis and synthesis), DhanpathRai& Sons, New Delhi, 1999.
4.	Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Second Edition, McGraw Hill, 2003.

BoS Chairman

B.E/B.Tech (Except CSBS)	B23ENI101–PROFESSIONAL COMMUNICATION	L	T	P	C
		3	0	2	4

Course Objectives	
1	To enhance listening and reading ability of learners to comprehend various forms of speech or conversations.
2	To develop learners' verbal ability through complex texts and speak effectively in real life and workplace context.
3	To make use of grammatical knowledge to enhance fluency.
4	To foster learners' ability to write convincing job applications and effective reports.
5	To develop learners language proficiency through LSRW skills

UNIT-I	9

Listening: Listening for general information-specific details- conversation- Audio /video (formal & informal); Telephone conversation

Speaking: Self-Introduction; Introducing a friend; - politeness strategies- making polite requests & polite offers.

Reading: Introduction to technical texts, scientific texts

Writing: Extended definitions, Writing checklists, Recommendation

Language development: Gerunds, Infinitives

Vocabulary development: Technical vocabulary, abbreviations, British & American spelling

UNIT-II	9

Listening: Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities

Speaking: Narrating personal experiences / Talking about events and situations

Reading: Reading longer technical texts, Summarizing

Writing: Interpreting graphical representations, Writing dialogues about formal and informal contexts.

Language development: Use of conjunctions and prepositions

Vocabulary development: Numerical adjectives, Transitional device

UNIT-III	9

Listening: Listen to a classroom lecture; listening to advertisements about products

Speaking: Picture description-describing locations in workplace, Presenting product, describing shape, size and weight- talking about quantities-talking about precautions, discussing advantages and disadvantages-making comparisons

Reading: Cause & effect texts, practice in speed reading

Writing: Process writing, Use of sequence words, Analytical and issue based essays

Language development: Subject verb agreement, Pronoun concord / pronoun antecedent

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Vocabulary development: Sequence words, Misspelled words, Content v/s Function words.

UNIT-IV	**9**
Listening: Listening to TED Talks, Educational videos and completing exercises based on them **Speaking:** Short speech (Just A Minute) -Extempore and persuasive speech, discussing and making plans-talking about tasks-talking about progress. **Reading:** Reading for details in personal and professional emails **Writing:** Drafting personal and professional emails, job application- cover letter, résumé preparation, Internship letter. **Language development:** Clauses, if conditionals **Vocabulary development:** Finding suitable synonyms, Paraphrasing	

UNIT-V	**9**
Listening: Listening to debates/ discussions and panel discussions, listening to interviews **Speaking:** Making predictions- talking about a given topic, giving opinions & facts, describing a process, discussing safety issues (making recommendations) **Reading:** Reading and understanding technical articles **Writing:** Writing reports, Minutes of meeting, Writing feasibility, survey and industrial reports **Language development:** Reported speech, Active and Passive voice, Impersonal passive, Idioms. **Vocabulary development:** Verbal analogies, Purpose statements	
	Total Theory Instructional hours:45 **Total Lab Instructional hours:30**

Course Outcomes: Students will be able to	
CO1	Develop listening skills to respond appropriately in general and academic purposes
CO2	Develop strategies and skills to enhance their ability to read and comprehend
CO3	Apply vocabulary skills to improve their language skills
CO4	Build the writing skills with specific reference to technical writing
CO5	Demonstrate language proficiency through LSRW skills

Text Books	
1.	Board of Editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2.	Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

Reference Books	
1.	Raman, Meenakshi and Sharma, Sangeetha “Technical Communication Principles and Practice”

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	Oxford University Press: New Delhi, 2014.
2.	Kumar, Suresh. E. “Engineering English” Orient Blackswan: Hyderabad, 2015
3.	Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4	Davis, Jason and Rhonda LIss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006
5	Communicative English for Engineers and Professionals- Nitin Bhatnagar & Mamta Bhatnagar
6	Skills for Success. Listening and Speaking. Level 4- Margret Brooks
7	Grammar F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University Press: Oxford, 2011

Exercises for Batch of 30 Students

1. Listening Comprehension
2. Self- introduction
3. Short presentation
4. Group Discussion

Approved by BoS Chairman

B.E / B.Tech	B23PHI101 - ENGINEERING PHYSICS (Common to all Branches)	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To gain knowledge on the basics of properties of matter, its applications and inculcate practical skills in the determination of elastic property of the materials.
2.	To acquire knowledge & experimental skills on the concepts of Photonics and their applications in fiberoptics.
3.	To have adequate knowledge on the concepts of electrical, magnetic properties of materials and enhance the practical skills in determination of electrical properties of the materials.
4.	To get knowledge on advanced physics concepts of quantum theory and its applications in SEM, TEM and induce practical skills in microscope.
5.	To enhance the fundamental knowledge of students in Crystal Physics and its Applications relevant to various streams of Engineering and Technology.

UNIT – I PROPERTIES OF MATTER	14

Elasticity-Modulus, types of modulii of elasticity, Stress-strain diagram and its uses-factors affecting elastic modulus and Twisting couple, torsion pendulum; theory and experiment.

Bending of beams- Bending moment - uniform and non- uniform bending; theory and experiment- I-shaped girders and its applications.

Determination of rigidity modulus – Torsion pendulum- Determination of Young's modulus by non-uniform bending method- Determination of Young's modulus by uniform bending method.

UNIT – II PHOTONICS AND FIBER OPTICS	12

Lasers; properties of laser-spontaneous and stimulated emission-amplification of light by population inversion- Einstein's A and B coefficients - derivation – Types of laser; Nd.-YAG Laser, Semiconductor lasers; homojunction and heterojunction, Industrial and Medical Applications.

Fiber Optics; Principle, Numerical Aperture and Acceptance Angle - Types of optical fibres–-Fiber optic communication System-Block diagram–Medical Applications-Endoscopy.

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Determination of wavelength of the Laser using grating- Determination of particle size using Laser- Determination of Numerical aperture and acceptance angle of an optical fiber.

UNIT – III ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS	12

Classical free electron theory – Relaxation time and collision time - Expression for electrical conductivity – Thermal conductivity – Wiedemann-Franz law –Lorentz number-Drawbacks of classical theory-Quantum theory- Fermi-Dirac statistics – variation of Fermi level with temperature.

Introduction to magnetic materials –Comparision of Dia, Para and Ferro magnetic materials – Domain theory of ferromagnetism- Hysteresis -Soft and Hard magnetic materials **-**Ferrites and its applications.

Determination of specific resistance of the wire using Carey Foster's Bridge.

UNIT – IV QUANTUM PHYSICS	12

Black body radiation; Planck's theory (derivation) - wave particle duality- debroglie's wavelength - concept of wave function and its physical significance.

Wave equation; Schroedinger's time independent and time dependent equations, particle in a one-dimensional rigid box. **Applications;** Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM).

Determination of thickness of a thin wire by using travelling microscope.

UNIT – V CRYSTAL PHYSICS	10

Crystal Structures; Single crystalline, polycrystalline and amorphous materials - unit cell- space lattice-crystal systems- Bravais lattices- Miller indices- inter-planar distances – coordination number and packing factor for SC, BCC, FCC and HCP structures.

Crystal imperfections; Point and Line defects-Burger vector.

	Total Theory Instructional hours : 60

Approved by BoS Chairman

Course Outcomes : Students will be able to	
CO1	Categorize the basics of properties of matter and its applications, classify the elastic properties of materials by using uniform, non-uniform bending method and torsional pendulum apparatus.
CO2	Explain the basics of Laser, Fiber Optics and their applications, determination of Particle size, Wavelength of laser and acceptance angle, numerical aperture of optical fiber.
CO3	Justify the concepts of electrical, magnetic properties of materials, determination of Specific resistance of the material.
CO4	Interpret the basic knowledge of quantum theory that could be helpful in understanding the wave functions of the particle and determination of thickness of thin sheet by using travelling microscope.
CO5	Classify and compare the different types of Crystals, their structures and its defects.

Text Books	
1.	Bhattacharya, D.K. & Poonam, T, "Engineering Physics", Oxford University Press,2015.
2.	Gaur, R.K. & Gupta, S.L. "Engineering Physics", Dhanpat Rai Publishers, 2012.
3.	Pandey, B.K. & Chaturvedi, S. "Engineering Physics", Cengage Learning India, 2012.
4.	Rajendran V, "Engineering Physics", Tata McGraw Hill, Publishing Company, NewDelhi, 2011.
5.	Wahab, M.A. —Solid State Physics: Structure and Properties of Materials, Narosa Publishing House, 2009.

Reference Books	
1.	Halliday, D., Resnick, R. & Walker, J. "Principles of Physics"", Wiley, 2015.
2.	Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers", CengageLearning, 2010.
3.	Tipler, P.A. &Mosca, G. "Physics for Scientists and Engineers with Modern Physics", W.H.Freeman, 2007.
4.	Avadhanulu M.N**, "**Engineering Physics - Volume 1", S.Chand & Company Ltd.,NewDelhi, 2010.
5.	Garcia, N. & Damask, A. —Physics for Computer Science Students. Springer-Verlag, 2012.
6.	Senthil Kumar, G. Physics Laboratory I & II, VRB publishers Pvt. Ltd., Chennai (2016).

Equipment Needed for 30 Students

1. Diode Laser (2 mS power) , He –Ne Laser source(2mW), Optical Fibre Kit - 06
2. Travelling Microscope ,Knife edge, Slotted weights - 19
3. Carey Foster Bridge - 06
4. Air Wedge Apparatus with Travelling Microscope - 06
5. Torsional Pendulum - 06

Approved by BoS Chairman

B.E / B.Tech	B23CEP201 – SOFT SKILLS (Common to all Branches)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To identify personality using evaluation method.
2.	To encourage creative thinking by practice.
3.	To enrich interpersonal skills through integrated activities.
4.	To develop social and professional etiquette.
5.	To identify and apply employability skills for professional success.

UNIT – I SELF EVALUATION	6
Introduction to soft skills, Familiarize oneself, Self-understanding, SWOT analysis, Goal Setting.	

UNIT – II INNOVATIVE THINKING	6
Divergent thinking, Encourage curiosity, Writing a story, Poster making.	

UNIT – III INTERPERSONAL SKILLS	6
Interpersonal skills - Need & Components – Understanding Intercultural Competence - Team Work- Problem Solving Skills - Conflict Management & Resolutions in Workplace, Leadership skills, Managerial skills.	

UNIT – IV BUSINESS ETIQUETTE	6
Define Etiquette -Types and Importance of Workplace Etiquette - Basic Corporate Etiquette - Telephone Etiquette - Meeting & E- mail Etiquette - Customer Service Etiquette.	

UNIT – V CORPORATE SKILLS	6
Work Ethics- Adaptability-Analytical Reasoning- Lateral Thinking-Stress & Time Management.	
	Total Instructional hours : 30

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Course Outcomes : Students will be able to	
CO1	Identify different personalities.
CO2	Show creative skill in different aspects.
CO3	Utilize leadership skills with ability to work in a team.
CO4	Analyze work place etiquette.
CO5	Develop adequate soft skills required for the workplace.

Reference Books	
1.	Butterfield, Jeff “Soft Skills for Everyone” Cengage Learning, New Delhi, 2015.
2.	S.Hariharanetal ”Soft Skills” MJP Publishers: Chennai, 2010.
3.	Peter, Francis “Soft Skills and Professional Communication” New Delhi: Tata McGraw Hill. 2012. Print.
4.	Meenakshi Raman, Shalini Upadhyay, ’Soft Skills’, Cengage Learning India Pvt. Ltd, Delhi, 2018.
5.	M.S.Rao, ‘Soft Skills Enhancing Employability’, I. K. International Publishing House Pvt. Ltd, New Delhi, 2010
6	Sabina Pillai, Agna Fernandez, ‘Soft Skills and Employability Skills’, Cambridge University Press, 2018.
7	John Peter.A, ‘Self – Development and Professional Excellence’, Cengage Learning India Pvt. Ltd, Delhi, 2019.

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Application Design and Development

Module I: Web Development Foundations (HTML & CSS)

Software Development Lifecycle (SDLC): Waterfall Model, Phases, Methods, and Best Practices - HTML: Introduction, Versions, HTML5 Standards & Tags, Semantic Elements, Forms, Media (Images, Audio, Video), Tables, Lists - CSS: Introduction, Selectors, Box Model (Margins, Padding, Borders), Colors & Backgrounds - Frameworks: Introduction to Bootstrap and Tailwind CSS

Module II: Interactive Web Development with JavaScript

JavaScript Basics: Variables, Data Types, Operators, Conditional Statements, Loops - Functions & Events: Function Declarations, Event Handling - DOM Manipulation: Document Object Model (DOM) - Form Handling: Validation, Page Redirection - Error Handling: Exception Handling in JavaScript

Module III: Version Control & Shell Scripting

Git & GitHub: Repositories, Branching, Merging, Remote Repositories - Advanced Git Actions: Pull Requests, Issues, Contribution to Open Source - Developer Communities: Google Developer Group, Stack Overflow, Kaggle - Shell Scripting: Process Management, File Handling, User & Group Management.

Total Hours: 15

Textbook:

1. Jon Duckett, "HTML and CSS: Design and Build Websites", John Wiley & Sons, Inc, 2011.
2. Marijn, Haverbeke, "Eloquent JavaScript: A Modern Introduction to Programming", 3rd Edition, William Pollock Publisher, 2019.
3. Scott Chacon and Ben Straub, "Pro Git", 2nd Edition, APress Publication, 2024.

Reference Book:

1. Jennifer Robbins, "Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics", O'Reilly Media, Inc., 2012.
2. Douglas Crockford, "JavaScript: The Good Parts", O'Reilly Publications, 2008.
3. Cameron Newham, "Learning the Bash Shell", 3rd Edition, O'Reilly Media, Inc, 2005.

Website Reference:

1. https://www.freecodecamp.org/
2. https://developer.mozilla.org/en-US/docs/Web/JavaScript
3. https://www.codecademy.com/catalog/subject/web-development

B. E / B.Tech	B23BMP201 – BIOSCIENCE LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To Estimate and quantify biomolecules.
2.	To understand the separation techniques of the biomolecules
3.	To study the features of compound microscope
4.	To learn various staining process.
5.	To study the chemical examinations, Histopathological examinations etc.

Expt. No.	Description of the Experiments
1.	Preparation of solutions: 1) percentage solutions, 2) molar solutions, 3) normal solutions
2.	Standardization of pH meter, preparation of buffers, emulsions.
3.	Spectroscopy: Determination of absorption maxima (λmax) of a given solution
4.	General tests for carbohydrates, proteins and lipids.
5.	Identification of Blood Collection Tubes and Phlebotomy equipment
6.	Estimation of Hemoglobin and blood glucose
7.	Estimation of urea and uric acid
8.	Separation of proteins by SDS electrophoresis (Demo) and amino acids by thin layer Chromatography (Demo).
9.	Basic staining – Hematoxylin and eosin staining.
10.	Types of Staining: Simple stain, Gram stain
11.	Study of parts of compound microscope
12.	Study of Histopathological slides of benign and malignant tumours.
13.	Study of Hematology slides of anemia and leukemia.

Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Make use of the biochemistry laboratory functional components
CO2	Analyze the parameters with interpretation
CO3	Explain the basics knowledge of Biochemical parameter and their interpretation in Blood sample.
CO4	Demonstrate practical experiments on staining Processes.
CO5	Explain with pathological slides of benign and malignant tumours.

Text Books	
1.	Ramnik Sood, Textbook of Medical Laboratory Technology, 6thEdition, Jaypee Brothers Medical Publishers, 2009

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
Sl. No.	**Description of Equipment**	**Quantity required**
1.	Colorimeter	2
2.	Spectrophotometer	1
3.	pH meter	1
4.	Weighing balance	1
5.	Refrigerator	1
6.	SDS gel electrophoresis	1
7.	TLC, ready TLC plates	1
8.	Wintrobe's tube	2
9.	Centrifuge Normal	1
10.	Microslides	2 Packets
11.	Lancet	5 Boxes
12.	Microscope	1
13.	Neubaur's Chamber	2
14.	Heparinized Syringe	1Box
15.	Haemoglobinometer	1
16.	Capillary tubes	1 box
17.	Phlebotomy equipment	2 box

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III SEMESTER

B.E.	B23MAT303 - TRANSFORMS AND PROBABILITY (BME)	L	T	P	C
		3	1	0	4

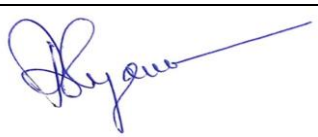
Course Objectives	
1.	To understand Fourier series analysis in representation of Periodic signals.
2.	To acquaint the student with Fourier transform techniques used in wide variety of situations.
3.	To develop the concept of Z transforms techniques for discrete time systems.
4.	To Introduce the basic concepts of probability and random variables.
5.	To Understand the basic concepts of two dimensional random variables.

UNIT – I FOURIER SERIES	12
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series- Parseval's identity – Harmonic analysis.	

UNIT – II FOURIER TRANSFORMS	12
Fourier transform pair – Fourier sine and cosine transforms – Properties (without proof) – Transforms of simple functions – Convolution theorem(without proof) – Parseval's identity.	

UNIT – III Z-TRANSFORMS AND DIFFERENCE EQUATIONS	12
Z-transforms – Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems – Convolution theorem (without proof) – Formation of difference equations – Solution of difference equations using Z – transforms.	

UNIT – IV ONE DIMENSIONAL RANDOM VARIABLES	12
Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson,Geometric, Uniform, Exponential and Normal distributions.	



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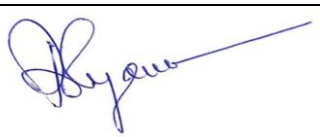
UNIT – V TWO DIMENSIONAL RANDOM VARIABLES	12
Definition - Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linearregression.	
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Solve differential equations using Fourier series analysis.
CO2	Develop Fourier transforms techniques in engineering problems.
CO3	Make use of Z- transforms to solve difference equations.
CO4	Interpret the concepts of probability and standard distributions.
CO5	Develop the concepts of one and two dimensional random variables and apply in engineering domain.

Text Books	
1.	Grewal B.S., “Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2020.
2.	Ibe, O.C., —Fundamentals of Applied Probability and Random Processes",Elsevier, 2nd Indian Reprint, 2014.

Reference Books	
1.	Erwin kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 10th Edition,New Delhi, 2015.
2.	Peter V.O Neil, "Advanced Engineering Mathematics", Cengage, New Delhi, 2016.
3.	Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education, 4th Edition, New Delhi, 2011.
4.	Hwei Hsu, "Schaum‘s Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2011.



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B.E/B.Tech	B23BMT301 – SENSORS AND MEASUREMENTS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the purpose of measurement, the methods of measurements, errors associated with measurements.
2.	To know the principle of transduction, classifications and the characteristics of different transducers.
3.	To learn the photoelectric and piezo electric sensors.
4.	To know the different bridges for measurement.
5.	To know the different display and recording devices.

UNIT - I	MEASUREMENT AND CALIBRATION	9

Measurement System – Instrumentation - Classification and Characteristics of Transducers Static and Dynamic - Errors in Measurements– Calibration -Primary and secondary standards.

UNIT - II	TRANSDUCERS AND ITS TYPES	9

Strain Gauge: Gauge factor, sensing elements, configuration, and unbounded strain gauge. Capacitive transducer, Inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics, Active type: Thermocouple – characteristics,

UNIT - III	TYPES OF SENSORS	9

Phototube, scintillation counter, photo multiplier tube (PMT), photovoltaic, photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers. Piezoelectric active transducer and biomedical applications as pressure & Ultrasound transducer. Introduction to biosensors- transduction mechanism in a biosensor and Classification.

UNIT - IV	SIGNAL CONDITIONING CIRCUITS	9

Functions of signal conditioning circuits, Preamplifiers, Concepts of passive filters, AC and DC Bridges - wheat stone bridge, Kelvin, Maxwell, Hay, Schering.

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UNIT - V	DISPLAY AND RECORDING DEVICES	9
Digital Multi meter – CRO – block diagram, DSO, LCD monitor, Multiparameter display, LED, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Make use of the concepts to measure various electrical parameters with accuracy, precision, resolution.
CO2	Select appropriate passive or active transducers for measurement of physical phenomenon.
CO3	Identify the appropriate light sensors for measurement of physical phenomenon.
CO4	Make use of AC and DC bridges for relevant parameter measurement.
CO5	Examine the working of multimeter, CRO and different types of recorders for appropriate measurement.

Text Books	
1.	A.K.Sawhney, “Electrical & Electronics Measurement and Instrumentation”,10th edition, Dhanpat Rai & Co, New Delhi, 19th Revised edition 2011, Reprint 2014
2.	John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.

Reference Books	
1.	Ernest O Doebelin and Dhanesh N Manik, “Measurement systems, Application and design”, 6th edition, McGraw-Hill, 2012
2.	Khandpur R.S, “Handbook of Biomedical Instrumentation”, 3 rd edition, Tata McGraw-Hill, New Delhi, 2014.
3.	Leslie Cromwell, “Biomedical Instrumentation and measurement”, 2nd edition, Prentice hall of India, New Delhi, 2015.

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B. E.	B23CSI303-FUNDAMENTALS OF DATA STRUCTURES USING C	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To acquire the concepts of data structures.
2.	To understand the usage linked lists.
3.	To understand the concepts of stacks and queues.
4.	To know the concepts of trees and graphs .
5.	To familiarize the concepts of sorting, searching and hashing techniques.

UNIT - I	INTRODUCTION	9
Abstract Data Types (ADTs), List ADT, array-based implementation – linked list implementation — singly linked lists- circularly linked lists - doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).		

UNIT - II	LINEAR DATA STRUCTURES- STACK	9
Stack ADT- definition, operations, array and linked implementations in C, applications-infix to postfix conversion, Postfix expression evaluation, recursion implementation.		

UNIT - III	LINEAR DATA STRUCTURES-QUEUE	9
Queue ADT - Types of Queue: Simple Queue, Circular Queue, Priority Queue, deQueue - Operations on each types of Queues (Insertion, Deletion, and Traversal) – applications of queues.		

UNIT - IV	NON-LINEAR DATA STRUCTURES- TREES & GRAPHS	9
Tree ADT - Tree traversals - Binary Tree ADT - expression trees - Applications of Trees - Binary Search Tree – Balanced Binary Tree- B -Trees – Heaps - Graph – Graph traversal Algorithms – Shortest Path Algorithms – Minimum Spanning Tree Algorithms		

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UNIT - V	SEARCHING, SORTING & HASHING	9
Searching- Linear Search - Binary Search. Sorting - Quick sort - Bubble sort - Merge sort - Selection sort - Hashing- Hash Function – Types of Hash Functions – Collision – Collision Resolution Technique – Perfect Hashing.		

Expt. No.	Description of the Experiments
1.	Implementation of Singly, Doubly and Circular Linked list using C
2.	Array implementation of Stack and Queue ADTs.
3.	Linked list implementation of Stack and Queue ADTs.
4.	Implementation of Tree traversal algorithms.
5.	Implementation of Binary Search Trees.
6	Implementation of AVL Trees.
7	Implementation of Shortest path and MST algorithms
8	Implementation of searching algorithms.
9	Implementation of sorting algorithms.
10	Hashing – collision resolution techniques.
Total Instructional hours : (45+15) = 60	

Course Outcomes : Students will be able to	
CO1	Identify suitable data structures for simple problems
CO2	Apply the linear data structures such as stacks and queues to solve problems.
CO3	Make use of tree data structures to provide solutions.
CO4	Apply the concept of graphs in real world scenarios.
CO5	Analyse various searching ,sorting and hashing techniques.

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Text Books	
1.	"C Programming Absolute Beginner's Guide" by Greg Perry and Dean Miller is the third edition, June 23, 2013
2	Pradip Dey and Manas Ghosh, —Programming in C, Second Edition, Oxford University Press, 2011.
3.	Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C, Second Edition, University Press, 2008

Reference Books	
1.	Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, Introduction to Algorithms", Fourth Edition, Mcgraw Hill/ MIT Press, 2022.
2.	"Data Structures Using C" by Aaron M. Tenenbaum, Yedidyah Langsam, and Moshe J. Augenstein ,2022
3.	"Data Structures and Algorithm Analysis in C" by Mark Allen Weiss,2022
4.	Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2016.
5.	Langsam, Augenstein and Tanenbaum, Data Structures Using C and C++, 2nd Edition, Pearson Education, 2015.

CO-PO Mapping Table:

Cos	K-Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO 1	PS O2
		K3	K3	K5	K4	K3	K3, A3	K2, A3	K3, A3	A3	A3	K3, A3	A3	K3, A3	K3, A3
CO1	K3	2	2	1	1	1	1	1	-	1	2	1	3	2	1
CO2	K3	2	2	1	1	1	-	-	-	1	1	1	2	2	2
CO3	K3	2	2	1	1	1	-	-	-	1	1	1	2	2	1
CO4	K3	2	2	1	1	1	-	-	-	2	1	1	2	2	3
CO5	K3	2	2	1	1	1	2	1	-	1	2	1	3	3	2
Weighted Average		2	2	1	1	1	1	1	-	1	1	1	2	2	2

3 – Substantial **2- Moderate** **1- Low '-' – No Correlation**

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B.E/ B.Tech	B23BMT302 –ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To Introduce the concept of diodes and its applications
2.	To Study the various characteristics of Bipolar junction Transistors and thyristors
3.	To Understand the concept behind the theory and operation of the basic Field-effect Transistors
4.	To familiarize the characteristics of amplifier gain and frequency response
5.	To learn the required functionality of positive and negative feedback systems

UNIT - I	PN JUNCTION DEVICES	9

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance –Rectifiers – Half Wave and Full Wave Rectifier– Clipping & Clamping circuits - Display devices- LED, Laser diodes, Zener diode characteristics- Zener diode Reverse characteristics – Zener diode as regulator

UNIT - II	BIPOLAR JUNCTION TRANSISTORS AND THYRISTORS	9

BJT, - structure, operation, Input and Output characteristics of CE, CB, CC characteristics and Biasing UJT, Thyristors - SCR, Diac, Triac, IGBT -Structure and characteristics

UNIT - III	FIELD EFFECT TRANSISTORS	9

JFET, MOSFET – structure, operation, Drain and Transfer characteristics, -Current equations-Pinch off voltage and its significance- Threshold voltage -Channel length modulation, small signal characteristics, D- MOSFET, E-MOSFET- Characteristics – Introduction to CMOS design ,FINFET, PINFET, CNTFET Comparison of JFET with BJT

UNIT - IV	AMPLIFIERS AND DIFFERENTIAL AMPLIFIER	

BJT small signal model – Analysis of CE, CB, CC amplifiers - Gain and frequency response - MOSFET small signal model – Analysis of CS and Source follower – Gain and frequency response Differential amplifier – Common mode and Difference mode analysis –power amplifiers –Types (Qualitative analysis).

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UNIT - V	FEEDBACK AMPLIFIERS AND OSCILLATORS	9
Advantages of negative feedback – voltage/current, series, Shunt feedback – positive feedback–Condition for oscillations, phaseshift–Wienbridge, Hartley,Colpitts and Crystal oscillators.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the structure and operation of PN junction devices
CO2	Analyze the structure and characteristics of BJT, UJT, Thyristor and IGBT
CO3	Analyze the structure and characteristics of JFET and MOSFET
CO4	Explain the various configurations of BJT , MOSFET and differential amplifier
CO5	Explain the operation of various feedback amplifiers and oscillators

Text Books	
1.	David A. Bell, “Electronic devices and circuits”, Oxford University higher education, 5th edition2008.
2.	Sedra and smith, “Microelectronic circuits”,7th edition, Oxford University Press.

Reference Books	
1.	Balbir Kumar,Shail.B.Jain,“Electronic devices and circuits”,PHI learning private limited, 2nd edition 2014.
2.	Thomas L.Floyd, “Electronic devices”, Conventional current version, Pearson prentice hall,10th Edition,2017.
3.	Donald A Neamen, “Electronic Circuit Analysis and Design”, Tata McGraw Hill, 3rd Edition,2003.
4.	Robert L.Boylestad, “Electronic Devices and Circuit Theory”,2002.
5.	RobertB.Northrop,“AnalysisandApplicationofAnalogElectronicCircuitstoBiomedicalInstrumentation”, CRC Press,2004.

Programme Coordinator

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B.E	B23ECT303 - SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives

1.	To understand the basic properties and characterization of signal & systems using MATLAB.
2.	To analyse continuous time signals in the Fourier and Laplace domain.
3.	To apply LTI continuous time system in the Fourier and Laplace domain.
4.	To analyse discrete time signals in the Fourier and Z transform domain.
5.	To apply LTI discrete time system in the Fourier and Z transform domain.

UNIT- I	CLASSIFICATION OF SIGNALS AND SYSTEMS	10

Standard signals - Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids – Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals Classification of systems - CT systems and DT systems – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

UNIT- II	ANALYSIS OF CONTINUOUS TIME SIGNALS	10

Fourier series for periodic signals Fourier Transform – properties - Laplace Transforms and properties.

UNIT- III	LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS	9

Impulse response - convolution integrals - Differential Equation - Fourier and Laplace transforms in Analysis of CT systems Systems connected in series / parallel.

UNIT- IV	ANALYSIS OF DISCRETE TIME SIGNALS	8

Baseband signal Sampling – Fourier Transform of discrete time signals (DTFT) - Properties of DTFT -Z Transform & Properties.

UNIT- V	LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS	8

Impulse response – Difference Equations - Convolution sum Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems DT systems connected in series and parallel.

Total Instructional hours: 45

Text Books	
1.	Allan V. Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, 2015. (Unit I - V)
Reference Books	
1.	B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford, 2009.
2.	R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems - Continuous and Discrete”, Pearson, 2007.
3.	John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.

Course Outcomes: Students will be able to	
CO1	Classify the various types of continuous and discrete time signals and systems using MATLAB
CO2	Analyze Continuous time signals in the Fourier and Laplace domain
CO3	Apply LTI Continuous time systems in the Fourier and Laplace domain
CO4	Analyze discrete time signals in the Fourier and Z transform domain
CO5	Apply LTI discrete time systems in the Fourier and Z transform domain

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B.E/ B.Tech	B23BMI303-ANATOMY AND HUMAN PHYSIOLOGY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To identify all the organelles of an animal cell and their function.
2.	To show the architecture of human body and process of gas exchanges.
3.	To demonstrate their knowledge of importance of circulation and defense mechanism of body.
4.	To understand the structure and function of nervous System and sense organs.
5.	To understand the functions of digestive, urinary and endocrine system.

UNIT - I	CELL AND TISSUE STRUCTURE	9

Structure of Cell – structure and functions of sub organelles – Cell Membrane –Transport of Across Cell Membrane - Action Potential – Cell to Cell Signaling – Cell Division. Types of Specialized tissues – Functions. Cell chemistry and its metabolic pathways-Disorders related to carbohydrates lipids and protiens.

UNIT - II	SKELETAL, MUSCULAR AND RESPIRATORY SYSTEM	9

Skeletal::Types of Bone and function – Physiology of Bone formation – Division of Skeleton–Types of joints and function – Types of cartilage and function. Muscular: Parts of Muscle. Respiratory: Parts of Respiratory Systems – Types of respiration - Mechanisms of Breathing – Regulation of Respiration-Measurement of vital parameters.

UNIT - III	BLOOD ,CARDIOVASCULAR AND LYMPHATIC SYSTEM	9

Composition of Blood and functions.- Blood Groups and importance –Blood vessel: Types , Structure of Heart – Conducting System of Heart – Properties of Cardiac Muscle - Cardiac Cycle - Heart Beat — Regulation of Heart rate and Blood pressure—Factors regulating blood flow. Lymphatic: Parts and Functions of Lymphatic systems – Types of Lymphatic organs and vessels- Measurement of vital parameters

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UNIT - IV	NERVOUS AND SENSE ORGANS	9
Structure of neuron -Types Neuroglial cells -synapses and types. Brain-division of brain lobes – cross section anatomy of brain -Cortial localization and functions. Spinal cord- Tracts of spinal cord – spinal nerve — reflex mechanism—Types of reflex. Anatonomic nervous system and function. Sense Organs: Eye and Ear- Measurement of vital parameters		

UNIT - V	DIGESTIVE ,URINARY AND ENDOCRINE SYSTEM	9
Digestive: Organs of Digestive system – Digestion and Absorption. Urinary: Structure of Kidney and Nephron – Mechanisms of Urine formation – Regulation of Blood pressure by Urinary System -Urinary reflex. Endocrine - Pituitary and thyroid gland- Measurement of vital parameters		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Summarize the Acquire knowledge in cell biology and elucidate the function of and cells and tissue organization Including their disorders.
CO2	Outline the architecture of human body and process of breathing.
CO3	Show the process of circulation and defense mechanism of body .
CO4	Explain the activity of sensor and motor nerve.
CO5	Illustrate the process of energy absorption and waste removal from human body and the gland involved in this process.

Text Books	
1.	Prabhjot Kaur. :"Text Book of Anatomy and Physiology". Lotus Publsihers. 2014
2.	Elaine.N. Marieb , "Essential of Human Anatomy and Physiology", Eight Edition, Pearson Education, New Delhi, 2007.

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Reference Books	
1.	Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, “Fundamentals of Anatomy and Physiology”. Pearson Publishers, 2014.
2.	Gillian Pocock, Christopher D. Richards,’ The human Body – An introduction for Biomedical Health Sciences”, Oxford University Press, USA, 2013.
3.	William F.Ganong, —”Review of Medical Physiology”, 22nd Edition, Mc Graw Hill, New Delhi,
4	Eldra Pearl Solomon, “Introduction to Human Anatomy and Physiology”, W.B.Saunders Company, 2015
5	Guyton & Hall, “Medical Physiology”, 13th Edition, Elsevier Saunders, 2015.
6	Ross and Wilson,” Anatomy and Physiology in Health and lllness”,14 Edition ,Oswaal Books and Learning Private Limited,2022

Programme Coordinator	Approved by BoS Chairman

B.E./B.Tech	B23BMP301 - ELECTRONIC DEVICES AND CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To gain, hand on experience in Thevenin & Norton theorem, KVL & KCL and Super Position Theorems
2.	To learn the characteristics of basic electronic devices such as PN junction Diode and Zener Diode
3.	To learn the applications of PN junction diode
4.	To learn the input-output characteristics using BJT
5.	To learn the characteristics of FET

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Verification of KVL and KCL
2.	Verification of Thevenin's and Norton's Theorems.
3.	Verification of superposition Theorem.
4.	Verification of Maximum power transfer and reciprocity theorems.
5.	Characteristics of PN Junction Diode
6.	Zener diode Characteristics
7.	Voltage regulation using Zener diode
8.	Half wave and Full wave rectifier with capacitor filter
9.	Clipper and Clamper Characteristics
10.	Common Emitter input-output Characteristics
11.	Common Base input-output Characteristics
12.	FET Characteristics

Total Instructional hours : 60

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Course Outcomes : Students will be able to	
CO1	Apply the circuit laws and theorems
CO2	Determine the VI characteristics of given PN junction diode, Zener diode,
CO3	Test half wave, full wave rectifier, clipping and clamper circuit using PN Junction diode
CO4	Determine the Input & output characteristics of BJT
CO5	Examine the characteristics of FET

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity required
1.	BC107, BC148, 2N2646, BFW10	25
2.	IN4007, Zener diodes	25
3.	Resistors, Capacitors, Inductors	100
4.	Bread Boards	15
5.	CRO (30MHz)	10
6.	Function Generators (3MHz)	10
7.	Dual Regulated Power Supplies (0 – 30V)	10

Programme Coordinator

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B.E./B.Tech	B23BMP302 - ANATOMY AND HUMAN PHYSIOLOGY LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To estimate and quantification of blood cells.
2.	To learn methods for identification of blood groups.
3.	To estimate hematological parameters
4.	To analyse the degree of inflammation.
5.	To analyze the visual and hearing test.

Total Instructional hours : 60

Expt. No.	Description of the Experiments
1.	Collection of blood samples
2.	Identification of Blood groups (Forward and Reverse)
3.	Bleeding and Clotting time
4.	Estimation of Haemoglobin
5.	Total RBC count
6.	Total WBC count
7.	Differential count of Blood cells
8.	Study on Estimation of ESR
9.	Study on MCH, MCV,MCHC
10	Hearing Test- Tuning Fork
11.	Visual Activity- Snellen's Chart and Jaeger's Chart

Programme Coordinator

Approved by BoS Chairman

Course Outcomes : Students will be able to	
CO1	Explain the basics of physiology of the major organs
CO2	Explain the function of blood cells.
CO3	Analyze the blood cells using microscope.
CO4	Estimate the amount of Hemoglobin in the blood.
CO5	Analyze the visual and hearing test

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity required
1.	Microscope	2
2.	Centrifuge Normal	1
3.	Wintrobes tube	2
4.	PCV Tube	2
5.	Neubaur chamber	2
6.	Herpanized syringe	1
7.	haeoglobinometer	1
8	Blood grouping kit	1
9.	Capillary tubes	1
10.	Ophthalmoscope	1
11.	Tuning fork (256 Hz to 512 Hz)	5
12.	Microslides (Packets)	2
13	Lancet (boxes)	5
14	Snellen's Chart and Jaeger'sChart	2

Programme Coordinator

Approved by BoS Chairman

B.E	B23ECP303 - SIGNALS AND SYSTEMS LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives	
1.	To study the various operations of signals and response of systems using appropriate tools

List of Experiments	
Expt. No.	**Description of the Experiments**
1	Generate discrete signal and calculate energy/ Power of a signal.
2	Understand the properties and the different representations of LTI systems
3	Understand the concept of convolution
4	Analyze the effects of sampling in the time and frequency domains
5.	Learn about uniform quantization
6	Discrete Fourier Analysis and Synthesis of Signals
7.	The given a real electrocardiogram (EGC) signal contains 500 data samples and sampled at a rate of 200 Hz. Detect the heart rate of the patient from which this ECG was taken.
	Total Instructional hours: 30

Course Outcomes: Students will be able to	
CO1	Examine the mathematical concepts on CT and DT signals using appropriate tools
CO2	Apply the mathematical concepts on CT and DT systems using appropriate tools
CO3	Analyze the concept of sampling and Quantization
CO4	Infer the properties of Discrete Time LTI systems
CO5	Experiment the concept of signals and systems in biomedical application.

List of Equipment Required: Requirements for a Batch of 30 Students

Sl. No.	Description of the Equipment	Quantity required (Nos.)
1.	Computer	30
2.	Software – Python/ Appropriate tools	-

Approved by BoS Chairman

IV SEMESTER

B.E/B.Tech	B23BMT401 - DIGITAL CIRCUITS AND DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study various number systems and to simplify the mathematical expressions using Boolean functions word problems .
2.	To study implementation of combinational circuits using Gates` and MSI Devices.
3.	To study the design of various synchronous sequential circuits.
4.	To introduce the analysis and design procedures for asynchronous sequential circuits
5.	To introduce semiconductor memories and related technology

UNIT - I	NUMBER SYSTEMS	9

Number system, error detection, corrections & codes conversions, Boolean algebra: DeMorgan's theorem, Introduction to K-maps & Quine McCluskey method.

UNIT - II	COMBINATIONAL CIRCUITS	9

Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps - simplification and implementation of combinational logic – multiplexers and de multiplexers – Magnitude comparator, adders, subtractors, Encoders and Decoders.

UNIT - III	SYNCHRONOUS SEQUENTIAL CIRCUITS	9

Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Mealy models- Counters, state diagram; state reduction; state assignment.

UNIT - IV	ASYNCHRONOUS SEQUENTIAL CIRCUITS	9

Asynchronous sequential logic Circuits-Transition stability, flow stability-race conditions, hazards &errors in digital circuits; analysis of asynchronous sequential logic circuits .

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UNIT - V	LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES	9
Logic families- Propagation Delay, Fan - In and Fan - Out - Noise Margin - RTL, TTL, ECL, CMOS - Comparison of Logic families - Implementation of combinational logic/sequential logic design using standard ICs, PROM, PLA and PAL, basic memory, static ROM,PROM,EPROM,EEPROM EAPROM.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Make use of Boolean algebra and simplification procedures relevant to digital logic.
CO2	Design various combinational digital circuits using logic gates.
CO3	Analyze the procedure for synchronous sequential circuits.
CO4	Analyze the procedure for asynchronous sequential circuits.
CO5	Build logic gates and use programmable devices.

Text Books	
1.	M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.

Reference Books	
1.	Tocci R.J., Neal S. Widmer, ‘Digital Systems: Principles and Applications’, Pearson Education Asia, 12th Edition, 2017.
2.	Thomas L. Floyd, “Digital Fundamentals”, 10th Edition, Pearson Education Inc, 2011.
3.	Donald P Leach, Albert Paul Malvino, Goutam Sha, ‘Digital Principles and Applications’, Tata McGraw Hill, 7th Edition, 2010.

Programme Coordinator	Approved by BoS Chairman

B.E/ B.Tech	B23BMT402-BIOSIGNAL PROCESSING	L	T	P	C
		3	1	0	4

Course Objectives	
1.	To learn discrete Fourier transforms, properties of DFT and its application in biosignal analysis.
2.	To understand the characteristics of digital IIR filters and its applications
3.	To understand the characteristics of digital FIR filters and its applications
4.	To understand the effects of finite precision representation on digital filters
5.	To learn the applications of signal processing in biomedical field

UNIT - I	DISCRETE FOURIER TRANSFORM	12
Introduction To DSP, DFT and its properties, FFT algorithms & its applications, Application of DFT in biosignal analysis -ECG,EEG etc.		

UNIT - II	DESIGN OF INFINITE IMPULSE RESPONSE FILTERS	12
Analog filters – Butterworth filters, Chebyshev Type I filters (upto 3rd order), Analog Transformation of prototype LPF to BPF /BSF/ HPF. Realization structures for IIR filters – direct, cascade, parallel forms. Application of noise removal in cardiac and neuro signals.		

UNIT - III	DESIGN OF FINITE IMPULSE RESPONSE FILTERS	12
Design of FIR filters windowing (Hamming and Hanning), and frequency sampling method. Application of noise removal in cardiac and neuro signals. Realization structures for FIR filters, Study of hardware used for the FIR filter implementation		

UNIT - IV	FINITE WORD LENGTH EFFECTS	12
Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.		

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UNIT - V	BIOSIGNAL ANALYSIS	12
Multirate signal processing-interpolation, decimation, Components and events detection -ECG, Adaptive filters for biosignal systems- Cardiac Feature extraction using different algorithm – Blind source separation- PCA, ICA		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Apply DFT for the analysis of digital signals and systems
CO2	Design IIR filters
CO3	Design FIR filters
CO4	Characterize the effects of finite precision representation on digital filters
CO5	To analyze the biomedical signals using various methods

Text Books	
1.	Arnon Cohen, “Bio-Medical Signal Processing Vol I and Vol II”, CRC Press Inc., Boca Rato, Florida, 1999..
2.	Rangaraj M. Rangayyan, “Biomedical Signal Analysis-A case study approach”, Wiley, 2nd Edition, 2016.

Reference Books	
1.	Willis J. Tompkins, “Biomedical Digital Signal Processing”, Prentice Hall of India, New Delhi, 2003.
2.	Emmanuel C. Ifeachor, Barrie W.Jervis, “Digital Signal processing- A Practical Approach’’,Pearson education Ltd., 2004.
3.	Raghuveer M. Rao and Ajith S.Bopardikar, “Wavelets transform – Introduction to theory and its applications”, Pearson Education, India, 2000.
4.	K.P.Soman, K.Ramachandran, “Insight into wavelet from theory to practice”, PHI, New Delhi, 3rd Edition, 2010.
5.	John L.Semmlow, “Biosignal and Biomedical Image Processing Matlab Based applications’’,Taylor& Francis Inc, 2004.
6	Kayvan Najarian and Robert Splerstor, “Biomedical signals and Image processing’’, CRC –Taylor and Francis, New York, 2nd Edition, 2012.

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B.E/B.Tech	B23BMT403 - BIO CONTROL SYSTEMS	L	T	P	C
		3	1	0	4

Course Objectives	
1.	To Understand the concept behind feedback and continuous in various systems and subsystems and the need for mathematical modeling of various systems.
2.	To Study the systems in time domains.
3.	To Learn the concept of stability of various systems.
4.	To Build the systems in frequency domains.
5.	To Analyze mathematical modeling principles in understanding the various fundamental biological systems.

UNIT - I	INTRODUCTION	9

Open and Closed loop Systems, Mathematical Modeling of systems, Block diagram and signal flow graph representation of systems - reduction of block diagram and signal flow graph, Introduction to Physiological control systems- Illustration, Linear models of physiological systems, Difference between engineering and physiological control systems.

UNIT - II	TIME RESPONSE ANALYSIS	9

Step and impulse responses of first order and second order systems - time domain specifications of first and second order systems - steady state error constants.

UNIT - III	STABILITY ANALYSIS	9

Definition of stability, Routh- Hurwitz criteria of stability, Root locus technique - construction of root locus and study of stability, Nyquist plot - Nyquist stability criterion, closed loop stability.

UNIT - IV	FREQUENCY RESPONSE ANALYSIS	9

Frequency domain specifications - Determination of closed loop response from open loop response, Polar plots - Bode plots – Applications of Nichol's chart.

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UNIT - V	BIOLOGICAL CONTROL SYSTEM ANALYSIS	9
Simple models of muscle stretch reflex action - steady state analysis of muscle stretch reflex action, Linearized respiratory mechanics- open loop versus closed loop, Regulation of urinary system, frequency response of circulatory control model.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Interpret the need for mathematical modeling of various systems, representation of systems in block diagrams and signal flow graphs and are introduced to biological control systems.
CO2	Develop the time response of various systems.
CO3	Apply the concept of system stability.
CO4	Examine the frequency response characteristics of various systems using different charts.
CO5	Simplify the concept of modeling basic physiological systems.

Text Books	
1.	I.J. Nagarath and M. Gopal, Control Systems Engineering, New Age International Publishers, 1st September, 2018.
2.	Michael C K Khoo, Physiological Control Systems, IEEE Press, Prentice Hall India, 2005.

Reference Books	
1.	Salivahanan S. Rengaraj R. and Venkatakrishnan G. R., Control Systems Engineering, Pearson Education India, 2015.
2.	Benjamin C. Kuo, Automatic Control Systems, Prentice Hall of India, 1995.
3.	Ogata, Katsuhiko and Yanjuan Yang, Modern control engineering, Vol 4, Prentice-Hall, 2002.

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B.E	B23ECT403 - LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

Course Objectives

1.	To introduce the basic building blocks of linear integrated circuits.
2.	To learn the linear and non-linear applications of operational amplifiers.
3.	To introduce the theory and applications of analog multipliers and PLL.
4.	To learn the theory of ADC and DAC.
5.	To introduce the concepts of waveform generation and introduce some special function ICs.

UNIT- I	BASICS OF OPERATIONAL AMPLIFIERS	9

Introduction to op-amps, stages, Current mirror and current sources, Widlar current source, Wilson current source DC and AC performance characteristics, slew rate, Open and closed loop configurations, Inverting and non-inverting amplifier, Introduction to FET based op-amps.

UNIT- II	APPLICATIONS OF OPERATIONAL AMPLIFIERS	9

Sign Changer, Scale Changer, Phase Shift Circuits, Adder, Subtractor, Differential amplifier, Instrumentation amplifier, Differentiator, Integrator, Comparator and its applications, Precision rectifiers, peak detector, clipper and clamper, Design of active filters.

UNIT- III	ANALOG MULTIPLIER AND PLL	9

Logarithmic amplifier, analog multiplier ICs and its applications, Variable trans-conductance multiplier - Four quadrant multiplier, Gilbert Multiplier cell, Operation of the basic PLL, Voltage controlled oscillator, Application of PLL.

UNIT- IV	ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS	9

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type.

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UNIT- V	WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS	9
Sine-wave generators, Multivibrators and Triangular wave generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator, Opto-couplers and fibre optic IC.		
	Total Instructional hours: 45	

Text Books	
1.	D. RoyChoudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2018, Fifth Edition. (Unit I – V)
2.	Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata McGraw-Hill, 2016. (Unit I – V)

Reference Books	
1.	Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015.
2.	Robert F.Coughlin, Frederick F.Drisco, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001.
3.	Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 5th Edition, 2009.
4.	S.Salivahanan& V.S. KanchanaBhaskaran, "Linear Integrated Circuits", TMH, 2nd Edition, 4th Reprint, 2016.

Course Outcomes: Students will be able to	
CO1	Explain the basics of operational amplifier
CO2	Analyze the linear and nonlinear applications of operational amplifiers
CO3	Identify and explain the applications of analog multiplier and PLL ICs
CO4	Examine the analog to digital and digital to analog converters using Op-Amps
CO5	Analyze different types of Operational Amplifier based waveform generators and special function ICs

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B.E/ B.Tech	B23BMT404 – BIOMATERIALS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To Learn characteristics and classification of Biomaterial
2.	To Understand different metals, ceramics and its nanomaterial's characteristics as biomaterials
3.	To Learn polymeric materials and its combinations that could be used as a tissue replacement implants
4.	To Get familiarized with the concepts of Tissue replacement
5.	To Understand the various Nano biomaterials and its applications

UNIT - I	INTRODUCTION TO BIO-MATERIALS	9

Definition and classification of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants, wound healing, blood compatibility, Nano scale phenomena- Impact and Future of Biomaterials

UNIT - II	METALLIC AND CERAMIC MATERIALS	9

Biomedical metals-types and properties - Metallic implants - Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion, ceramic implant – bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bio ceramics - Orthopedic implants

UNIT - III	POLYMERIC IMPLANT MATERIALS	9

Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin. Medical Textiles, Materials for ophthalmology: contact lens, intraocular lens. Membranes for plasma separation and Blood oxygenation, electro spinning: a new approach.

UNIT - IV	TISSUE REPLACEMENT IMPLANTS	9

Small intestinal sub mucosa and other decullarized matrix biomaterials for tissue repair: Extra cellular Matrix. Soft tissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, tissue scaffolding and engineering using Nano biomaterials.

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UNIT - V	NANO BIOMATERIALS AND ITS APPLICATIONS	9
Carbon based nanobiomaterials - Nanocomposites - Nanopolymers - nanofibres- Nanosurface and coats-Applications of Nano biomaterials - nano antibiotics – Nanomedicines - Biochips		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain different types of Biomaterials and its classification
CO2	Identify Various Metallic and Ceramics materials used as Biomaterials
CO3	Identify the various Polymer Biomaterials and its applications
CO4	Demonstrate the various Tissue Replacement Implants
CO5	Expalin the various nanobiomaterials and its applications.

Text Books	
1.	Sujata V. Bhatt, “Biomaterials”, Second Edition, Narosa Publishing House, 2005.
2.	Joon B.Park Joseph D. Bronzino, “Biomaterials - Principles and Applications”, CRC press,

Reference Books	
1.	Sreeram Ramakrishna, Murugan Ramalingam, T. S. Sampath Kumar, and Winston O. Soboyejo, “Biomaterials: A Nano Approach”, CRC Press, 2010.
2.	Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and Krati Jain. “Implant biomaterials: A comprehensive review”, World Journal of Clinical Cases, 2015.
3.	Biomaterials- Basic Theory with Engineering Applications C.Mauli Agarwal, Joo L.Ong, Mark R. Appleford, Gopinath Mani. Cambridge University Press, New York- 2016.

Programme Coordinator	Approved by BoS Chairman

B.E/ B.Tech	B23BMT405– BIOMECHANICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study the overview of biomechanics
2.	To learn about the cardiac mechanics
3.	To learn about the orthopedic mechanics
4.	To understand the orthopedic applications and develop prosthetics
5.	To understand and analyze the various mathematical models for biomechanics application

UNIT - I	INTRODUCTION	9
Scope of mechanics in medicine, Biomechanics and Body Movements, Body-Segment Coordinate Systems.		

UNIT - II	CARDIAC MECHANICS	9
Biomechanics of Normal Cardiac Function, Mechanical properties of blood vessels: arteries, arterioles, capillaries, veins, prosthetic heart valves & replacements. Cardiac Biomechanics And Disease detection		

UNIT - III	ORTHOPAEDIC MECHANICS	9
Biomechanics of articular cartilage, Biomechanics of bone, Kinetics & Kinematics of joints, Lubrication of joints. Biomechanics of the Spine: Basic Concepts, Spinal Disorders, and Treatment,		

UNIT - IV	ORTHOPAEDIC APPLICATIONS	
Gait analysis, above knee, below knee prosthesis, Upper limb, lower limb prosthetics, Foot braces, Multitask exoskeletal, .Biomechanical analysis of scoliotic spine, Design of prosthetics and orthotics		

Programme Coordinator	Approved by BoS Chairman

UNIT - V	MATHEMATICAL MODELS	9
Introduction to Finite Element Analysis, Mathematical models - pulse wave velocities in arteries, determination of in-vivo elasticity of blood vessel, dynamics of fluid filled catheters. Numerical finite element models in hard tissue mechanics, soft tissue mechanics.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Interpret the use of mechanics in medicine.
CO2	Explain the cardiac mechanics
CO3	Infer about Orthopedic mechanics
CO4	Develop the models specific to orthopaedic applications.
CO5	Analyze the biomechanical systems using mathematical models

Text Books	
1.	Y.C.Fung,—Bio-Mechanics, “Mechanical Properties of Tissues’’,Springer- Verilog,1998.
2.	C. Ross Ether and Craig A.Simmons, “Introductory Biomechanics from cells to organisms”, Cambridge University Press, New Delhi, 2009.

Reference Books	
1.	Susan J Hall, “Basics of Biomechanics’’, Mc Graw Hill Publishing.co. New York, 5th Edition, 2007.
2.	Dhanjoo N.Ghista, “Orthopedic Mechanics”, Academic Press, 1990
3.	Joseph D.Bronzino, “Biomedical Engineering Fundamentals”, Taylor& Francis, 2006.
4.	John Enderle, Susanblanchard, Joseph Bronzino, “Introduction to Biomedical Engineering’’, Elsevier, 2005.
5.	H.Brown, PV Lawford, RH Small wood, DR Hose, Dc Barber, “Medical Physics and Biomedical Engineering’’, CRC Press, 1999.,

Programme Coordinator

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B.E./B.Tech	B23BMP401- BIO SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To implement the generation of sequences.
2.	To realize Linear and Circular Convolution.
3.	To realize FIR and IIR filters.
4.	To implement signal processing applications
5.	To study of architecture of Digital Signal Processor

List of Experiments	
Expt. No.	**Description of the Experiments**
MAT LAB / Equivalent Software package	
1.	Generation of elementary Discrete-Time sequences
2.	Linear and Circular convolutions
3.	Autocorrelation and cross-correlation
4.	FFT and IFFT
5.	Difference equation Representation
6.	Digital IIR Butterworth filter-LPF & HPF
7.	Digital IIR chebychev filter-LPF & HPF
8.	Design of FIR filter using windowing technique
9.	Upsampling and downsampling
10.	Analysis of ECG
11.	Analysis of EEG
12.	Study of architecture of Digital Signal Processor
Total Instructional hours : 60	

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Course Outcomes : Students will be able to	
CO1	Apply DFT for the analysis of digital signals and systems
CO2	Design IIR and FIR filters
CO3	Design multirate filters
CO4	Analyze bio signal processing
CO5	Identify the features of the digital signal processors.

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS:		
S.No.	**Description of the Equipment**	**Qty.**
1.	MATLAB with Simulink and Signal Processing Tool Box or Equivalent Software in desktop systems	15

15

Programme Coordinator

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B. E / B.Tech	B23BMP402 - LINEAR AND DIGITAL INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To design and simulate analog and digital circuits.
2.	To implement operational amplifiers in linear and nonlinear applications.
3.	To learn the working of Active filter, special function ICs use simulation software.
4.	To Design and implement the Combinational logic circuits.
5.	To Design and implement the Sequential logic circuits.

Expt. No.	Description of the Experiments
Design and Analyze the following analog circuits.	
1.	Inverting, Non inverting and Differential amplifiers.
2.	Integrator and Differentiator
3.	Active low-pass and High-pass filter
4.	Schmitt Trigger.
5.	Astable and monostable multivibrators using NE555 Timer.
Design the following digital circuits	
6	Study of logic gates.
7	Half adder and Full adder.
8	Design and implementation of code converters using logic gates (i) BCD to excess-3 code and vice versa (ii) Binary to gray and vice-versa
9.	Design and implementation of Multiplexer and De-multiplexer using logic gates
10	Design and implementation of encoder and decoder using logic gates.
Design and simulate the following analog and digital circuits	
11	Wein bridge oscillator
12	RC phase shift oscillator

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13	Construction and verification of 4 bit ripple counter.
14.	Design and Implementation of Shift Register
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Design and implement the circuits for different applications using op-amp.
CO2	Design wave form Generators and analyze their characteristics.
CO3	Analyze the performance of filters and special function ICs
CO4	Design Combinational Circuits using logic gates
CO5	Design Sequential circuits using logic gates.

Text Books	
1.	D. Roy Choudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt.Ltd., 2018, Fifth Edition.
2.	M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS

S.No	Name of Equipment’s	Quantity
1.	Dual Regulated Power Supplies (0 – 30V)	10
2.	Cathode Ray Oscilloscope (0-30Mhz)	10
3.	Function Generator (0-3Mhz)	10
4.	Trainer KIT	10
5.	**Analog Circuits** IC 741, IC555	Each 10 nos.
6.	**Digital Circuits** IC7400,IC7402, IC7404, IC7408, IC7432, IC7413, IC7411, IC7476, IC 7474,	Each 10 nos.
7.	Resistance : 1K, 10K,100K	Each 10 nos.
8.	Capacitor : 1mF, 10mF, 100mF/25v	Each 10 nos.
9.	Power card.	10nos.
10.	CRO BNC Cable.	10nos.

Programme Coordinator

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B.E/ B.Tech	B23CEP301 – RUDIMENTS OF MEDICAL EQUIPMENT	L	T	P	C
		-	-	-	1

Course Objectives	
1.	To demonstrate the basic principle of Medical Equipment
2.	To demonstrate the medical equipment used in the measurement of parameters related to cardiology
3.	To examine and gain knowledge about the respiratory devices
4.	To demonstrate and learn some of the cardiac assist devices
5.	To evaluate the electrical stimulation techniques used in clinical applications

UNIT - I	HANDS-ON TRAINING ON BASIC MEDICAL EQUIPMENT	6
Demonstration of Stethoscope, Sphygmomanometer, Thermometer, Otoscope, Hearing Aid, Laryngoscope		

UNIT - II	HANDS-ON TRAINING ON CARDIO-CARE EQUIPMENT	6
Circulatory system, Demonstration of, 3 Channel, Electrocardiogram(ECG) machine, Fetal doppler		

UNIT - III	PRACTICAL EXPOSURE ON RESPIRATORY CARE DEVICES	6
Respiratory system - Respirometer, Jet, Mesh and Ultrasonic Nebulizer, Fingertip wired and wireless Pulse-oximeter, OxygenConcentrator, C-PAP Machine		

UNIT - IV	DEMONSTRATION OF CRITICAL CARE EQUIPMENT AND PHYSIOTHERAPY EQUIPMENT	6
ICU unit – Demonstration and Application of Infusion Pump, SyringePump and Suction Pump - Patient Monitoring System		

UNIT - V	APPLICATION OF PHYSIO THERAPY EQUIPMENT	6
Physio Therapy – Study about Nerve and Muscular System – Accupen, BodyStimulator, Transcutanous Electrical Nerve Stimulator (TENS)		
	TOTAL INSTRUCTIONAL HOURS: 30	

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Course Outcomes : Students will be able to	
CO1	Interpret the various parameters with accuracy and precision
CO2	Illustrate and explain the mode of operation of various instrument and its medical applications.
CO3	Examine and adjust the technical factors of the instruments
CO4	Interpret the static and dynamic characteristics of bioinstrumentation systems
CO5	Evaluate and solve the problem and servicing the instrument properly

Text Books	
1.	S. Ananthi, “A Textbook of Medical Instruments”, New Age International Publishers,2005
2.	John G. Webster , “Medical Instrumentation Application and Design”, January 2015

Reference Books	
1.	Introduction To Biomedical Equipment Technology 4th Edition by Joseph J Carr, Pearson India
2.	https://www.taylorfrancis.com/books/edit/10.1201/9781003220671/medical-devices-prakash-srinivasan-timiri-shanmugam?_ga=1882759292.1702080000

Programme Coordinator	**Approved by BoS Chairman**

Semester - V

B.E. / B.Tech	B23BMT501 – BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the origin of bio potentials and its propagations.
2.	To design bio amplifier for various physiological recordings.
3.	To know the measurement techniques of electrical parameters.
4.	To learn the different measurement techniques for non-physiological parameters.
5.	To summarize different biochemical measurements.

UNIT - I	FUNDAMENTALS OF BIO POTENTIAL ELECTRODES	9
Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode – skin interface, half- cell potential, Contact impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Flexible and wearable bioelectrodes for continuous monitoring.		

UNIT - II	SIGNAL CONDITIONING CIRCUITS	9
Introduction to Bio-amplifier, Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation methods - isolated DC amplifier and AC carrier amplifier, Artifacts in biomedical signals and removal techniques.		

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UNIT - III	MEASUREMENT OF ELECTRICAL PARAMETERS	9
Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system, Principles of vector cardiography. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG – unipolar and bipolar mode. Techniques for recording ERG, EOG, and EGG signals.		

UNIT - IV	MEASUREMENT OF NON-ELECTRICAL PARAMETERS	9
Temperature, respiration rate and pulse rate measurements. Blood Pressure : indirect methods - Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement : Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement, Non-invasive continuous monitoring devices.		

UNIT - V	BIOCHEMICAL MEASUREMENT AND BIOSENSORS	9
Biochemical sensors - principles and applications of pH, pO_2, and pCO_2 sensors, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose monitoring technologies, Instrumentation for biochemical analysis : colorimeters, spectrophotometers, Electrolytes analyzer, Emerging biosensor technologies : lab-on-a-chip and point-of-care devices, Wearable biosensors for real-time health monitoring.		
		Total Instructional hours : 45

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Course Outcomes : Students will be able to	
CO1	Explain the origin of bio-potentials, electrode interfaces, and different types of bio- electrodes
CO2	Interpret the bio amplifier for various physiological recordings.
CO3	Illustrate the various techniques of electrical parameters.
CO4	Explain various technique of non-electrical phycological measurements.
CO5	Classify different biochemical measurement and biosensors.

Text Books	
1.	Leslie Cromwell, “Biomedical Instrumentation and measurement”, 2nd edition, Prentice hall of India, New Delhi, 2015.

Reference Books	
1.	John G. Webster, Medical Instrumentation Application and Design, 4th edition, Wiley India PvtLtd,New Delhi, 2015.

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2.	Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson Education, 2004.
3.	MyerKutz, Standard Hand book of Biomedical Engineering and Design, McGrawHill Publisher, 2003.
4.	Khandpur R.S, Handbook of Biomedical Instrumentation, 3rd edition, Tata McGraw- Hill, New Delhi, 2014.

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B.E. / B.Tech	B23BMT502 – EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To Introduce Fundamentals of Embedded systems.
2.	To understand the concept of processors and peripheral interfacing.
3.	To study programming aspects of embedded system design.
4.	To have a basic knowledge of Embedded system in diagnostic applications.
5.	To study about the various IoMT assist devices used in the hospitals.

UNIT - I	INTRODUCTION TO EMBEDDED SYSTEM DESIGN	9

Introduction to embedded processors - Application Areas - Categories of embedded processors - Challenges in Embedded System Design, Design Process - Requirements - Specifications - Hardware architecture - Software architecture - Introduction to Harvard & Von Neuman architectures - CISC & RISC Architectures. CPU Bus - Bus Protocols - Bus Organization, Memory Devices, and their Characteristics - RAM, EEPROM - Flash Memory - DRAM. BIOS, POST, Device Drivers.

UNIT - II	PROCESSORS AND PERIPHERAL INTERFACING	9

Embedded processors , I/O Devices - Timers and Counters - Watchdog Timers, Interrupt Controllers - A/D and D/A, Interfacing - Memory interfacing with a case study - I/O Device Interfacing with case Study - Interfacing Protocols - SPI, I2C, USB, CAN, Ethernet / WiFi, Bluetooth.

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UNIT - III	EMBEDDED SYSTEM SOFTWARE DESIGN	9
Application Software, System Software, Design techniques – State diagrams, sequence diagrams, flowcharts, etc., Model-based system engineering (MBSE), Use of High-Level Languages-embedded C / C++ Programming, Integrated Development Environment tools- Editor- Compiler- Linker- Automatic Code Generators- Debugger- Board Support Library- Chip Support Library, Analysis and Optimization- Execution Time- Energy & Power.		
UNIT - IV	**EMBEDDED SYSTEM FOR DIAGNOSTIC APPLICATIONS**	**9**
ICU patient monitoring system – ECG - EEG - EMG acquisition system - MRI scanner - CT scanner Sonography.		
UNIT - V	**INTERNET OF MEDICAL THINGS (IoMT) ASSIST DEVICES**	**9**
Case studies – Novel Symmetrical Uncertainty Measure (NSUM) Technique for Diabetes Patients, Healthcare Monitoring system through Cyber - physical system, A Fuzzy - Based expert System to diagnose Alzheimer's Disease, Secured architecture for lot enabled Personalized Healthcare Systems, Healthcare Application Development in Mobile and Cloud Environments.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Demonstrate the fundamental of embedded system.
CO2	Illustrate about processors and I/O devices and its importance.
CO3	Explain software design tools and embedded system design programming phases.
CO4	Compare various embedded diagnostic applications.
CO5	Build and analyze of some internet of medical things for assist devices.

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Text Books	
1.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, “IoT Fundamentals : Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.
2.	Embedded Systems – A Contemporary Design Tool, James K Peckol,John Weily, 2008, ISBN : 0- 444-51616-6.
3.	Venkata Krishna, Sasikumar Gurumoorthy, Mohammad S. Obaidat, “Internet of Things and Personalized Healthcare Systems”, Springer Briefs in Applied Sciences, and Technology, Forensic and Medical Bioinformatics, 2019
Reference Books	
1.	John G.Webster, “Medical Instrumentation Application and Design”, 3rd Edition, Wiley India Edition, 2007
2.	Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw Hill, New Delhi, 3rd Edition, 2014.
3.	Richard S.Cobbold, Transducers for Biomedical Measurements; Principle and applications John Wiley and sons, 1992.

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B.E. / B.Tech	B23BMT503 – INTERNET OF THINGS IN HEALTHCARE	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand IoT architecture and its impact on healthcare systems.
2.	To explore smart health devices and their integration with systems.
3.	To learn IoT security, data privacy, and ethical healthcare practices.
4.	To design and evaluate patient-friendly, cloud-connected IoT solutions.
5.	To analyze innovations and real-world applications of healthcare IoT.

UNIT - I	INTRODUCTION TO INTERNET OF THINGS (IOT) IN HEALTHCARE	9
Architecture of IoT in healthcare systems - Evolution of healthcare technology - IoT's role in transforming the medical field - Telemedicine, remote monitoring, chronic disease management - Improving efficiency, reducing errors, and providing personalized care - Overview of smart healthcare solutions and their impact on patient care.		

UNIT - II	SMART HEALTHCARE DEVICES AND INTEROPERABILITY IN IOT	9
Classification of IoT Healthcare Devices - Key Functionalities and Performance Metrics - Interoperability and Integration Challenges - Smart Device Data Formats and Handling – Device Ecosystems and Vendor Platforms - Cloud-Based Device Management.		

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UNIT - III	IOT CYBERSECURITY & ETHICAL CONSIDERATIONS	9
Common threats in healthcare IoT devices - Best practices for secure communication, device authentication, and encryption - Patient data privacy laws and their implications for IoT healthcare systems - Risk management and regulatory compliance for IoT.		

UNIT - IV	DESIGNING IOT-BASED HEALTHCARE SOLUTIONS	9
Designing a simple IoT health device - Integration of IoT devices with cloud platforms Usability testing and user experience feedback in healthcare IoT solutions monitoring and control - Designing intuitive, patient - friendly mobile and web interfaces - Deployment and Monitoring of Healthcare IoT Systems – Interface : Pulse rate, temperature, Humidity, Flex, Force, Accelerometer, Gyroscope, Infrared, LDR, Ultrasonic, Touch sensor – LED & Buzzer Interface – Display Interface – Cloud Interface – Relay Interface – AC Relay control – Medical device auto switching – Data sharing – Master & Slave – Data logging – Mobile Application control.		
UNIT - V	**EMERGING TRENDS AND CASE STUDIES IN IOT HEALTHCARE**	**9**
AI-IoT convergence in precision medicine - Digital therapeutics and virtual care delivery - How AI is enhancing the capabilities of IoT devices for diagnosis, monitoring, and decision - making - Future outlook : 6G, quantum IoT, and biosensing innovations - Case studies of AI - driven healthcare solutions - Post-operative remote monitoring - Fall detection systems for the elderly - AI-enabled wearable ECG patches.		
		Total Instructional hours : 45

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Course Outcomes : Students will be able to	
CO1	Explain the IoT architecture and its impact on healthcare systems.
CO2	Classify smart healthcare devices and integrate with IOT
CO3	Apply IoT security, data privacy, and ethical healthcare practices.
CO4	Develop patient-friendly, cloud-connected IoT solutions.
CO5	Analyze innovations and real-world applications of healthcare IoT.

Text Books	
1.	M. Kaur, R. K. Singh, R. Buyya : Internet of Things in Healthcare : Concepts, Technologies, and Applications, CRC Press, 2020

Reference Books	
1.	Chinmay Chakraborty, S. Balakrishnan, V. P. Singh : Internet of Things for Healthcare Technologies, Springer, 2020
2.	Hsinchun Chen, Kuan-Ching Li, D. : Smart Healthcare Systems : Innovation,Design and Security, Springer, 2022
3.	Alasdair Gilchrist : IoT Security Issues, Apress, 2017

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B.E / CSE(AI&ML)	B23AMI301 OBJECT ORIENTED PROGRAMMING USING JAVA	T	P	TU	C
		2	4	0	4

Course Objectives:

1. To understand the basic concepts of java programming.
2. To learn about object and classes and its methods.
3. To understand the inheritance and polymorphism techniques to develop software applications.
4. To apply appropriate exception handling mechanism in problem solving.
5. To get exposure to the various I/O programming techniques.

UNIT-I INTRODUCTION TO JAVA 9

Basics of JAVA programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Array in Java.

UNIT -II OBJECTS AND CLASSES 9

Basics of objects and classes in java, constructor, Finalizer, Visibility modifiers, methods and objects, inbuilt classes like String, Character, String Buffer, File, this reference.

UNIT -III INHERITANCE AND POLYMORPHISM 9

Inheritance in Java, Super and sub class, Overriding, Object class, Polymorphism, Dynamic binding, Generic programming, Casting objects, Instance of operator, Abstract class, Interface in JAVA, package in JAVA, UTIL package.

UNIT -IV MULTITHREADING 9

Thread life cycle and methods, runnable interface, thread synchronization, exception handling with try-catch, finally, collection in java.

UNIT - V I/O PROGRAMMING 9

Text and Binary, Binary I/O classes, object I/O, random access files, Serialization and Deserialization

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concepts.

List of Experiments

Expt. No.	Description of the Experiments
1	Write a java program for recursive and non-recursive functions
2	Write a java program for matrix multiplication.
3	Write a java program for Method overloading and Constructor overloading
4	write a java program for looping concepts
5	Write a java program to display the employee details using Scanner class
6	Write a java program using String functions
7	a) Write a java program to represent Abstract class with example. b) Write a java program to implement Interface using extends keyword
8	a) Write a java program to create user defined package b) Write a java program to create inner classes
9	a) Write a java program for creating multiple catch blocks b) Write a java program for producer and consumer problem using Threads
10	Write a Java program that implements a multi-thread application that has three threads
11	a) Write a java program to display File class properties b) Write a java program to represent Array List class c)Write a Java program loads phone no, name from a text file using hash table
12	Write an applet program that displays a simple message
13	a) Write a Java program using Applet b) Write a program for passing parameters using Applet
14	Write a java program for Event handling
15	Write a java program that connects to a database using JDBC
16	a) Write a java program to connect to a database using JDBC and insert values into it b) Write a java program to connect to a database using JDBC and delete values from it
17	Write a java program that works as a simple calculator. Use a Grid Layout to arrange Buttons for digits and for the + - * % operations. Add a text field to display the result

Total Instructional hours: 75

Course Outcomes:

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Students will be able to

CO1: Make Use of the syntax and semantics of java programming language and basic concepts of OOP.

CO2: Apply object oriented concepts on real time scenarios.

CO3 : Develop Inheritance and polymorphism mechanisms to create efficient software **applications.**

CO4: Apply exception handling and multithreading techniques to create Java applications to solve real world problems.

CO5 : Experiment with Standard input-output operations.

Text Books:

1. Herbert Scheldt, “Java the complete reference”, 9th edition, McGraw Hill Education, 2014.

2. T. Budd, “Understanding Object-Oriented Programming with Java”, updated edition, Pearson Education, 2000.

Reference Books:

1. Daniel Liang, “Introduction to Java Programming”, (Comprehensive Version), Seventh Edition, Pearson,2009.

2. Sachin Malhotra & Saurabh Chaudhary, “Programming in Java”, Oxford University Press,2014

3. Herbert Schild, “The Complete Reference”, Java 2 (Fourth Edition), TMH,2017.

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List of Equipment Required:

Requirements for a Batch of 30 Students

Sl. No.	Description of the Equipment	Quantity required (Nos.)
1.	Hp Pro 3090 Operating systems: Windows* 7 or later, macOS, and Linux. Java 11 and above, Tomcat Apache, Netbeans 8.X and above	30

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B.E / B.Tech	B23MCT505- Holistic Insights into UN SDGs (Common to ALL)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To understand the origin, purpose, and significance of the UN Sustainable Development Goals (SDGs).
2.	To explore the 17 SDGs, their interconnections, and challenges in achieving them.
3.	To analyze global and local case studies of SDG implementation.
4.	To evaluate the role of governments, businesses, and individuals in sustainable development.
5.	To develop practical solutions and action plans for achieving SDGs at community and policy levels

SYLLABUS:

UNIT - I	INTRODUCTION TO SUSTAINABLE DEVELOPMENT & SDGS	6

Concept of **sustainability** and its evolution.

UN Millennium Development Goals (MDGs) vs. Sustainable Development Goals (SDGs).

Overview of the **17 SDGs**, their targets, and indicators.

Importance of **global collaboration** for sustainable development.

UNIT - II	PEOPLE-CENTERED SDGS (SDG 1–6)	6

SDG 1: No Poverty – Causes, measures & policies.

SDG 2: Zero Hunger – Food security & sustainable agriculture.

SDG 3: Good Health & Well-being – Universal healthcare & disease prevention.

SDG 4: Quality Education – Inclusive and equitable education.

SDG 5: Gender Equality – Women's empowerment & equal opportunities.

SDG 6: Clean Water & Sanitation – Water conservation & access to sanitation.

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UNIT - III	ECONOMIC & INFRASTRUCTURE SDGS (SDG 7–12)	6
SDG 7: Affordable & Clean Energy – Renewable energy solutions. **SDG 8:** Decent Work & Economic Growth – Inclusive economic policies. **SDG 9:** Industry, Innovation & Infrastructure – Sustainable development & digital transformation. **SDG 10:** Reduced Inequalities – Social inclusion & global justice. **SDG 11:** Sustainable Cities & Communities – Smart urban planning & resilience. **SDG 12:** Responsible Consumption & Production – Circular economy & waste management.		

UNIT - IV	ENVIRONMENTAL SDGS (SDG 13–15)	6
SDG 13: Climate Action – Climate change impacts & mitigation strategies. **SDG 14:** Life Below Water – Ocean conservation & marine biodiversity. **SDG 15:** Life on Land – Forest preservation & biodiversity protection.		

UNIT - V	Governance & Global Partnerships (SDG 16–17)	6
SDG 16: Peace, Justice & Strong Institutions – Human rights & good governance. **SDG 17:** Partnerships for the Goals – Role of international cooperation, businesses & individuals.		

Course Outcomes: Students will be able to	
CO1	**Explain** the origin, purpose, and significance of the UN Sustainable Development Goals.
CO2	**Summarize** the 17 SDGs, their interconnections, and challenges in achieving them.
CO3	**Interpret** global and local case studies of SDG implementation.
CO4	**Describe** the roles of governments, businesses, and individuals in sustainable development.
CO5	**Illustrate** practical solutions and action plans for achieving SDGs at community and policy levels.

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Text Books	
1.	Sachs, J. D. (2015). The Age of Sustainable Development. Columbia University Press.
2.	United Nations (2015). Transforming Our World: The 2030 Agenda for Sustainable Development.
3.	Griggs, D., Stafford-Smith, M., Gaffney, O., & Rockström, J. (2017). Sustainable Development Goals: Harnessing Business to Achieve the SDGs Through Finance, Technology and Innovation. Routledge.
4.	Mebratu, D., & Swilling, M**. (2019).** Transformational Infrastructure for Development of a Wellbeing Economy. Springer.

Reference Books	
1.	**Leal Filho, W. (Ed.). (2020).** *Encyclopedia of the UN Sustainable Development Goals.* Springer.
2.	**Sachs, J. D. (2021).** *The Decade of Action: Mobilizing the World to Achieve the SDGs.* Columbia University Press.

Approved by BoS Chairman

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B. E / B.Tech	B23BMP501 – EMBEDDED SYSTEM AND IOMT LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To learn the internal architecture and programming of an embedded Controller
2.	To understand the hardware architecture and programming aspects of embedded system design.
3.	To Understand IoT architecture and Build simple IoT Systems using embedded target boards.
4.	To build a small low-cost embedded IoT system using Arduino / Raspberry Pi / open platform.
5.	To apply the concept of the IoMT infrastructure for healthcare applications.

Expt. No.	Description of the Experiments
1.	Explore AVR/ARM based controllers using Embedded C.
2.	Write Basic and arithmetic Programs Using Embedded C.
3.	Write Embedded C program to test interrupt and timers.
4.	Develop Real time applications – clock generation, waveform generation, counter using embedded C.
5.	Explore different communication methods with IoT devices.

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6.	To interface LED/Buzzer with platform/ Aurdino /Raspberry Pi. and write an embedded C program to turn on / off LED/Buzzer with specified delay.
7.	To interface DC/stepper motor using relay with open platform/ Aurdino /Raspberry Pi. and write an embedded C program to turn on motor if push button is pressed.
8.	Develop simple application – testing infrared sensor – IoT Applications – using open platform/Raspberry Pi.
9	Develop IoMT Application using open platform/ Aurdino. /Raspberry Pi. and sensors such as temperature, ECG, Pulse etc.
10	Deploy IoMT applications using platforms.
11	Mini Project.
	Total Instructional hours : 60

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
Sl. No.	**Description of Equipment**	**Quantity required**
1.	Arduino Atmega328	8
2.	ARM Controller Board	8
3.	Humidity Sensor DHT 11	8
4.	Temperature Sensor	8
5.	ECG Sensor	8
6.	Infrared Sensor	8

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7.	Bluetooth/ Wifi Modules	5
8.	Raspberry PI B+	5
9.	DC Stepper Motor / Servomotor 12V	5
10.	Pulse sensor	5
11.	Pulse oximeter	1
12.	Buzzer	10
13.	LED (Red)	10
14	Relay	8
15	IR sensor	8
16	Ultrasonic sensor	8
17	ECG sensor	5
18	FSR sensor	5
19	Display	8
20	Accelerometer &gyroscope Sensor	5

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Course Outcomes : Students will be able to	
CO1	Explain the architecture of embedded processors.
CO2	Write embedded C programs.
CO3	Design simple embedded applications.
CO4	Exhibit understanding of IoMT infrastructure for healthcare with simple applications.
CO5	Design IoT applications using Arduino / Raspberry Pi / open platform.

Text Books	
1.	Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.

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B. E / B.Tech	B23BMP502 – BIOMEDICAL INSTRUMENTATION LABORATORY	T	P	TU	C
		0	2	0	2

Course Objectives	
1.	To demonstrate on designing of ECG and EMG acquisition system.
2.	To measure physiological parameters and biochemical parameters.
3.	To demonstrate the optical Isolation amplifiers.
4.	To design EOG acquisition system.
5.	To design a PCB layout using software tool.

List of Experiments

Expt. No.	Description of the Experiments
1.	Design of ECG Amplifiers to detect QRS complex and measure heartrate.
2.	Design of EMG amplifier
3.	Design of EEG using EEG simulator
4.	Design of EOG amplifier to detect eye blink.
5.	Design and study the characteristics of optical Isolation amplifiers.
6.	Measurement of pulse-rate using Photo transducer.
7.	Measurement of blood pressure using a sphygmomanometer.
8.	Measurement and recording of peripheral blood flow using Doppler Flow meter.

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9.	Design a PCB layout for any bio amplifier using a suitable open-source software tool.
10.	Electrocardiogram (ECG) for bipolar limb leads l1,l2 and l3. using Virtual Lab
11.	Electroencephalogram (EEG) signal for different lobes using Virtual Lab
	Total Instructional hours : 30

Course Outcomes : Students will be able to	
CO1	Design preamplifiers and amplifiers for various ECG, EMG and EEG.
CO2	Measure various non-electrical parameters using suitable sensors / transducers.
CO3	Design optical isolation amplifier.
CO4	Design amplifier for EOG.
CO5	Design PCB layout for any bio amplifier.

Text Books	
1.	Leslie Cromwell, “Biomedical Instrumentation and measurement”, 2nd edition, Prentice hall of India, New Delhi, 2015.

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
Sl. No.	**Description of Equipment**	**Quantity required**
1.	Multiparameter (ECG, EMG, EEG) Simulator	1 No
2	ECG Amplifier	1 No
3	EOG Amplifier	1 No
4	Optical isolation amplifier	1 No
5	Photo transducer for pulse measurement	1 No
6.	Sphygmomanometer and Stethoscope	1 No
7.	Blood flow measurement system	1 No
8.	Open-source Software tool for PCB design	1 No
9.	Function generator, DSO, Regulated Power supplies	2 No

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B. E / B.Tech	B23CEP501 – SUMMER INTERNSHIP	L	T	P	C
		-	-	-	1

Course Objectives	
1.	To get connected with reputed industry / laboratory / academia / research institute.
2.	To gain practical knowledge on Product Development / Services and operations / Software Design and Development / Testing / Analytics / research / start-ups/professionalism/business processes and insights / domain knowledge/ Industry Practices/ and other related aspects and develop skills to solve related problems.
3.	To Develop technical, soft, team skills to cater to the needs of the industry / academia/businesses / research / organizations in the core aspects of Automation, Digitalization.

SUGGESTED GUIDELINES FOR STUDENTS

The students may undergo industrial training / Internship if mandated in the curriculum for periods as specified in the curriculum during the summer / winter vacation, the training being taken on a continuous basis for the periods mentioned. The industry / organization is to be selected with the approval of the Department Evaluation Committee (DEC). The students may undergo Internship at a Research organization / University / Industry (after due approval from the Head of the Institution) for the period prescribed in the curriculum during the summer / winter vacation, in lieu of Industrial training. The Industrial training / Practical Training/ Internship / Summer Projects / Seminars / Professional Practices / Case Study which is successfully completed by the student in a particular semester during the course of study is eligible for including in the grade sheet in the immediate next semester by registering it.

Students should perform following activities and prepare reports and give presentation in front of Department Evaluation Committee (DEC).

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Semester - VI

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B.E. / B.Tech	B23BMT601 – DIAGNOSTIC AND THERAPEUTIC EQUIPMENT	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To Understand the working of cardiac devices for the measurement of cardiology related parameters.
2.	To interpret the recording and measurement of neurological parameters.
3.	To solve problems related to the measurement of EMG setup and Biomechanical parameters.
4.	To describe various respiratory parameters using therapeutic devices.
5.	To apply various biological sensors for different applications.

UNIT - I	CARDIAC EQUIPMENT	9
Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, Cardiac Pacemaker - Internal and External Pacemaker – Batteries, A.C. and D.C. Defibrillator - Patient monitoring system - Principles of bio telemetry.		

UNIT - II	NEUROLOGICAL EQUIPMENT	9
Clinical significance of EEG, Multi-channel EEG recording system, Epilepsy, Evoked Potential – Visual, Auditory and Somatosensory, MEG (Magneto Encephalograph). EEG Bio-Feedback Instrumentation.		

UNIT - III	MUSCULAR AND BIOMECHANICAL MEASUREMENTS	9
Generation of EMG, Recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio-Feedback Instrumentation. Static Measurement – Load Cell, Pedobarograph. Dynamic Measurement – Velocity, Acceleration, GAIT, Limb Position.		

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UNIT - IV	RESPIRATORY MEASUREMENT SYSTEM	9
Instrumentation for measuring the mechanics of breathing – Spirometer - Lung Volume and vital capacity, measurements of residual volume, Pneumotacho meter – Airway resistance measurement, Whole body Plethysmograph, Intra-Alveolar, and Thoracic pressure measurements, Apnoea Monitor. Types of Ventilators – Pressure, Volume, and Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.		

UNIT - V	SENSORY MEASUREMENT	9
Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer - Pure tone, Speech, Eye Tonometer, Application Tonometer, slit lamp, auto refractometer.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Summarize the working and recording setup of all essential cardiac equipment.
CO2	Explain the working and recording of all essential neurological equipment.
CO3	Utilize the measurement techniques for acquiring muscular signals.
CO4	Infer about respiratory measurement system.
CO5	Experiment with different sensory instruments to solve a problems arises in a new situation.

Text Books	
1.	Joseph J. Carr and John M. Brown, “Introduction to Biomedical equipment technology”, Pearson Education, 4th Edition, 2014.
2.	John G.Webster, “Medical Instrumentation Application and Design”, John Wiley and Sons, New York, 4th Edition, 2009.

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Reference Books	
1.	Myer Kutz, “Biomedical Engineering & Design Handbook: Volume 2”, McGraw-Hill Publisher, 2nd Edition, 2009.
2.	L.A Geddes and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, John Wiley and Sons, 3rd Edition, Reprint 2008
3.	Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, “Biomedical Instrumentation and Measurements”, Pearson Education India; 2nd Edition, 2015.

		L	T	P	C

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B.E. / B.Tech	B23BMT602 – RADIOLOGICAL EQUIPMENT	3	0	0	3

Course Objectives	
1.	To understand generation of x-rays and its applications in imaging.
2.	To explain the principle of Computed Tomography.
3.	To learn the concepts of Magnetic Resonance Imaging.
4.	To know techniques of nuclear imaging system.
5.	To gain the knowledge of ultrasound imaging system.

UNIT - I	MEDICAL X-RAY EQUIPMENT	9

Nature of X-rays, X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, collimator, Bucky Grid, power supply. Digital Radiography-discrete digital detectors, storage phosphor and film scanning. Computed Radiography, Fluoroscopy - X-ray Image Intensifier tubes – Digital Fluoroscopy. Angiography - cine Angiography, Digital subtraction Angiography. Mammography Case studies.

UNIT - II	COMPUTED TOMOGRAPHY	9

Principles of tomography, CT Generations - X-Ray sources, collimation, X-Ray detectors, Viewing systems, spiral CT scanning, ultra-fast CT scanners, PET, SPECT, RSO,TLD, Image reconstruction techniques, back projection and iterative method. Case studies.

UNIT - III	MAGNETIC RESONANCE IMAGING	9

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Fundamentals of magnetic resonance - Interaction of Nuclei with static magnetic field and Radiofrequency wave, rotation and precession. Induction of magnetic resonance signals – bulk Magnetization, Relaxation processes T_1 and T_2. Slice Selection, Phase encoding and Frequency Encoding, Block Diagram approach of MRI system- system Magnet (Permanent, Electromagnet and Super conductors), Gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components. fMRI. Case studies.

UNIT - IV	NUCLEAR IMAGING SYSTEM	9

Radio Isotopes, Radiopharmaceuticals, Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors. Gamma camera- Principle of operation, collimator, photo multiplier tube, pulse height Analyzer, Nuclear imaging – Anger scintillation camera – Nuclear tomography – Single Photon Emission Computed Tomography, Positron Emission Tomography. Case studies.

UNIT - V	ULTRASONIC IMAGING SYSTEM	9

Diagnostic Ultrasound, Physics of Ultrasonic waves, Basic pulse-echo apparatus, Principles of A-Mode, B-Mode, M-Mode, Real time Ultrasonic (B-Scan) imaging systems, Requirements, Multielement Linear array scanners, Digital scan converters, Biological effects of ultrasound. Case studies.

Total Instructional hours : 45

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Course Outcomes : Students will be able to	
CO1	IIustrate the X ray and fluoroscopic principles and its working.
CO2	Show the principles and working of CT machines and differentiate its reconstruction techniques.
CO3	Translate about the principles of MRI techniques.
CO4	Make use of the techniques of nuclear imaging systems.
CO5	Explain the concept of ultrasound imaging system.

Text Books	
1.	Steve Webb, “The Physics of Medical Imaging’’, Adam Hilger, Philadelpia, 1988.
2.	Jerrold T. Bushberg, J. Anthony Seibert, Edwin M. Leidholdt, Jr, John M.Boone, “The Essential Physics of Medical Imaging’’, Lippincott Williams and Wilkins, 3rd Edition, 2012.

Reference Books	
1.	Gopal B. Saha, “Physics and Radiobiology of Nuclear Medicine’’, Springer, 3rd Edition 2006.
2.	B.H. Brown, PV Lawford, RH Smallwood, DR Hose, DC Barber, “Medical physics and Biomedical Engineering’’, CRC Press,1999.
3.	Myer Kutz, “Standard handbook of Biomedical Engineering and design”, McGraw Hill, 2003.
4.	Ragunathan, “Magnetic Resonance Imaging and Spectroscopy in Medicine concepts and Techniques’’, Orient Longman,2007. M. Analoui, J.D. Bronzino, D.R. Peterson, “Medical Imaging : Principles and Practices”, CRC Press, 2012.

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B.E. / B.Tech	B23BMT502 REHABILITATION ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To explain the need for medical aids.
2.	To understand the sensory rehabilitation systems
3.	To learn the use of the prosthetics and orthotics in rehabilitation
4.	To study the virtual reality in rehabilitation.
5.	To learn the legal aspects for building rehabilitation aids .

UNIT - I	INTRODUCTION	9

Definition - Impairments, disabilities and handicaps, Primary and secondary disabilities, Activities of daily living, Appropriate Technology, Residual function. Rehabilitation. Rehabilitation team – members and their functions. Rehabilitation care –Need for proper delivery of rehabilitation care, Community based rehabilitation and its aspects.

UNIT - II	SENSORY REHABILITATION ENGINEERING	9

Sensory augmentation and substitution- Visual system: Visual augmentation, Tactual vision substitution, and Auditory vision substitution. Auditory system- Auditory augmentation, Hearing aids, cochlear implants, visual auditory substitution, tactual auditory substitution. Tactual system, Tactual augmentation, Tactual substitution, Computerized wheel chairs.

UNIT - III	MOTOR REHABILITATION	9

Engineering concepts in motor rehabilitation, Artificial limbs- body powered, externally powered and controlled orthotics and prosthetics, Exoskeletons, Myoelectric hand and arm prosthetics. Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS).

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UNIT - IV	VIRTUAL REALITY IN REHABILITATION	9
Introduction to virtual reality, Cognitive skills rehabilitation, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.		

UNIT - V	REHABILITATION MEDICINE AND ADVOCACY	9
Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the basics concepts of rehabilitation engineering
CO2	Outline about assistive technology for vision & hearing.
CO3	Illustrate the fundamentals and application of motor rehabilitation
CO4	Select virtual reality tools for different aids
CO5	Summarize the legal aspects for building rehabilitation aids for the needed People

Text Books	
1.	Joseph D Bronzino, “The Biomedical Engineering Handbook”. 2nd edition, CRC Press,2000.
2.	Robinson C.J, “Rehabilitation Engineering”, CRC Press , 2006

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Reference Books	
1.	Sashi S Kommu, “Rehabilitation Robotics”, 1st edition, CRC Press, 2007. Sunder, “Textbooks of Rehabilitation”, Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007.
2.	Horia- Nocholai Teodorecu, L.C.Jain, “Intelligent systems and technologies in rehabilitation Engineering”, CRC; December 2000.
3.	Etienne Grandjean, Harold Oldroyd, “Fitting the task to the man”, Taylor & Francis,1988.
4	Marion A Hersh, Michael A, Johnson, “Assistive Technology for Visually impaired and blind people”, Springer Publications, First edition, 2008.

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B.E. / B.Tech	BM 23BMT604 – BIO MEMS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Understand the various MEMS fabrication techniques.
2.	Recognize different types of sensors and actuators and their principles of operation at the micro scale level.
3.	Know the basic principles of Electrostatic and Piezoelectric sensors and Actuators.
4.	Understand the MEMS microfluidic systems.
5.	Know the application of MEMS in different fields of medicine.

UNIT - I	MEMS MATERIALS AND FABRICATION	9
Typical MEMs and Microsystems, materials for MEMS - active substrate Materials-Silicon and its compounds, Silicon piezo resistors, Gallium Arsenide, quartz, polymers. Micromachining photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA.		

UNIT - II	MECHANICAL AND THERMAL SENSORS AND ACTUATORS	9
Mechanics for MEMS design - static bending of thin plates, mechanical vibration, thermomechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever – microplates, strain, pressure and flow measurements, Thermal sensors and actuators - actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys - Inertia sensor, flow sensor.		

UNIT - III	ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS	9
Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor.		

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UNIT - IV	MICROFLUIDIC SYSTEMS	9
Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in micro conduits, in submicrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micro pumps-continuous flow system, micromixers.		

UNIT - V	APPLICATIONS OF BIOMEMS	9
CAD for MEMS, Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR), DNA sensor, MEMS based drug delivery, Biosensors - sensors for glucose, uric acid, urea and triglyceride sensor.		
	Total Instructional hours : 45	

Course Outcomes : Students will be able to	
CO1	Explain the various MEMS fabrication techniques.
CO2	Classify the different types of sensors and actuators and their principles of operation at the micro-scale level.
CO3	Make use of the MEMS applications in Electrostatics and Piezo electric Principles.
CO4	Interpret the MEMS Microfluidic systems.
CO5	Apply the BIOMEMS various medical applications.

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Text Books	
1.	Tai Ran Hsu, “MEMS and Microsystems Design and Manufacture”, Tata McGraw Hill Publishing Company, New Delhi, 2002.
2.	Wanjun Wang, Stephen A.Soper, ”BioMEMS : Technologies and Applications”, CRC Press, New York, 2007

Reference Books	
1.	Marc J. Madou “Fundamentals of Microfabrication : the Science of Miniaturization”, CRC Press, 2002.
2.	Nadim Maluf, Kirt Williams. “An introduction to Microelectro Mechancial Systems Engineering”, Second Edition, Artech House Inc, MA, 2004.
3.	Chang Liu,’ Foundations of MEMS’, Pearson Education International, New Jersey, USA, 2006.
4.	Nitaigour Premchand Mahalik, “MEMS”, Tata McGraw Hill Publishing Company, New Delhi, 2007.

Program Coordinator

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B.Tech CSBS	B23MCT605 CYBER SAFETY CONCEPTS	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To understand various types of cyber-attacks and cyber-crimes
2.	To learn threats and risks within context of the cyber security
3.	To have an overview of the cyber laws & concepts of cyber forensics
4.	To study the defensive techniques against these attacks
5.	To understand various cyber security privacy issues

UNIT- I	Introduction to Cyber Security	9

Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT- II	Cyberspace and the Law & Cyber Forensics	9

Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics

UNIT- III	Cybercrime: Mobile and Wireless Devices	9

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Organizational security Policies and Measures in
Mobile Computing Era, Laptops.

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UNIT- IV	Cyber Security	9
Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations		

UNIT- V	Privacy Issues	9
Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains medical, financial, etc.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Analyze and evaluate the cyber security needs of an organization.
CO2	Understand Cyber Security Regulations and Roles of International Law.
CO3	Design and develop a security architecture for an organization.
CO4	Understand fundamental concepts of data privacy attacks.
CO5	Explain fundamental concepts of data privacy and analyze the role of privacy policies and privacy- preserving techniques.

Text Books	
1.	Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
2.	B.B. Gupta, D.P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335,2018.
Reference Books	
1.	Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2.	Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

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B. E / B.Tech	B23BMP601–DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY	0	0	4	2

Course Objectives	
1.	To demonstrate recording and analysis of different Bio potentials
2.	To study about the measurement of non-electrical parameters.
3.	To examine different diagnostic and therapeutic techniques.
4.	To study about electrical safety measurements.
5.	To know the analyzing techniques of different bio signals.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Measurement of visually evoked potential
2.	Galvanic skin resistance (GSR) measurement
3.	Shortwave and ultrasonic diathermy
4.	Measurement of various physiological signals using biotelemetry
5.	Study of hemodialysis model
6.	Electrical safety measurements
7.	Measurement of Respiratory parameters using spirometry
8.	Study of medical stimulator
9.	Analyze the working of ESU – cutting and coagulation modes
10.	Recording of Audiogram
11.	Acquisition and analysis of ECG,EEG and EMG signal

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12.	Study of ventilators
13.	Study of Ultrasound Scanners
14.	Study of heart lung machine model

Course Outcomes : Students will be able to	
CO1	Measure different bioelectrical signals using various method.
CO2	Compare different non-electrical parameters using various methodologies.
CO3	Illustrate various diagnostic and therapeutic techniques.
CO4	Examine the electrical safety measurements.
CO5	Analyze the different bio signals using suitable tools.

Text Books	
1.	John G. Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, New York, 4th Edition, 2009.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
Sl. No.	**Description of Equipment**	**Quantity required**
1.	Visually evoked potential setup	1 No.
2.	GSR setup	1 No.
3.	Multi-output power supply (+15v, -15v, +30V variable, +5V, 2A):	2 Nos.
4.	Short wave Diathermy	1 No.
5.	Ultrasound diathermy	1 No.
6.	Multiparameter biotelemetry system	1 No.
7.	Electrical Safety Analyzer.	1 No.
8.	Spirometry with associated analysis system	1 No.

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9.	ECG Simulator.	1 No.
10.	Medical stimulator	1 No.
11.	Surgical diathermy with analyzer	1 No.
12.	Audiometer	1No
13.	Pacemaker and Defibrillator:	1 No
14.	Hemodialysis model and Heart lung Model	1 No. each
15.	Ventilator:	1 No.
16.	Ultrasound Scanner:	1 No.

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B. E / B.Tech	B23BMP602–INNOVATIVE DESIGN PRACTICES	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To develop skills to formulate a technical project.
2.	To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of a Biomedical / Electronics / Mechatronic / Instrumentation system.
3.	To teach use of new tools, algorithms and techniques required to carry out the projects.
4.	To give guidance on the various procedures for validation of the product and analyze the cost effectiveness.
5.	To gain experience in organization and implementation of a small project and thus acquire the necessary confidence to carry out main project in the final year.
6.	To provide guidelines to prepare technical report of the project.

Course Outcomes : Students will be able to	
CO1	Formulate a real-world problem, identify the requirement and develop the design solutions.
CO2	Express technical ideas, strategies and methodologies.
CO3	Utilize the new tools, algorithms, techniques that contribute to obtaining the solution of the project.
CO4	Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
CO5	Prepare report and present the oral demonstrations.

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Vertical - 1

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B.E. / B.Tech	B23BME901 – WEARABLE BIOMEDICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the fundamentals of wearable sensor technology.
2.	To impart knowledge on electronics in wearable system design.
3.	To enable knowledge development on principles of energy harvesting.
4.	To understand the need for BAN and the challenges involved in the design of BAN.
5.	To provide insight to wearable systems for continuous monitoring and diagnosis.

UNIT - I	SENSORS FOR WEARABLE SYSTEM	9

Need for wearable systems, Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor, GSR, Radiant thermal sensor, Wearable motion sensors, CMOS – Based Biosensors, E-Textiles, Bio compatibility.

UNIT - II	SENSOR DESIGN AND SIGNAL ACQUISITION	9

Wearability issues - physical shape and placement of sensor, technical challenges - sensor design, signal acquisition, Constraint on sampling frequency for reduced energy consumption, light weight signal processing, Rejection of irrelevant information, Datamining.

UNIT - III	ENERGY HARVESTING FOR WEARABLE DEVICES	9

Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

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UNIT - IV	WIRELESS HEALTH SYSTEMS	9
Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges - System security and reliability, BAN Architecture – Introduction, Wireless communication techniques.		

UNIT - V	APPLICATIONS OF WEARABLE SYSTEMS	9
Medical Monitoring - Patients with chronic disease, Hospital patients, Elderly patients, Multi parameter monitoring, Neural recording, Gait analysis, Sports Medicine, Smart Fabrics.		
	Total Instructional hours : 45	

Course Outcomes : Students will be able to	
CO1	Choose the appropriate sensor for specific wearable application.
CO2	Develop signal processing techniques for wearable systems.
CO3	Assess the energy requirement for a wearable system and choose the appropriate energy harvesting technique for wearable systems.
CO4	Understand the need for BAN and the challenges involved in the design of BAN.
CO5	Analyze applications of Wearable systems.

Text Books	
1.	Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.
2.	Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkata subramanian, “Body Area Networks Safety, Security, and Sustainability”, Cambridge University Press, 2013.

Reference Books	
1.	Hang, Yuan-Ting, “Wearable medical sensors and systems”, Springer - 2013.

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2.	Mehmet R. Yuce, Jamil Y. Khan, “Wireless Body Area Networks Technology, Implementation and Applications”, Pan Stanford Publishing Pvt. Ltd, Singapore, 2012.
3.	Guang-Zhong Yang (Ed.), “Body Sensor Networks”, Springer, 2006.
4.	Andreas Lymberis, Danilo de Rossi, “Wearable eHealth systems for Personalized Health Management - State of the art and future challenges”, IOS press, Netherlands, 2004.

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B.E. / B.Tech	B23BME902 – BODY AREA NETWORK	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the BAN architecture and the technical challenge.
2.	To study the suitable hardware for BAN.
3.	To learn the efficiency of communication and the security parameters.
4.	To understand the need for the medical device regulations and regulations followed in various regions.
5.	To familiarize with the various BAN applications.

UNIT - I	INTRODUCTION	9
Definition, BAN and Healthcare, Technical Challenges - Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction.		

UNIT - II	HARDWARE FOR BAN	9
Processor - Low Power MCUs, Mobile Computing MCUs, Integrated processor with radio transceiver, Memory, Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources - Batteries and fuel cells for sensor nodes.		

UNIT - III	WIRELESS COMMUNICATION AND NETWORK	9
RF communication in Body, Antenna design and testing, Propagation, Base Station - Network topology - Stand – Alone BAN, Wireless personal Area Network Technologies - Standard IEEE 802.15.1 Bluetooth wireless technology, Standard IEEE 802.15.14 for impulse radio ultra wideband (UWB) wireless ad hoc connectivity, Zigbee. Standard IEEE 802.15.6 - short-range, low-power, and highly reliable wireless communication.		

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UNIT - IV	COEXISTENCE ISSUES WITH BAN	9
Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures on physical layer and data link layer, Regulatory issues - Medical Device regulation in USA and Asia, Security and Self-protection - Bacterial attacks, Virus infection, Secured protocols, Self-protection.		

UNIT - V	APPLICATIONS OF BAN	9
Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmia monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Understand the BAN architecture and the technical challenge.
CO2	Select the suitable hardware for BAN.
CO3	Assess the efficiency of communication and the security parameters.
CO4	Understand the need for the medical device regulations and regulations followed in various regions.
CO5	Analyze the various BAN applications.

Text Books	
1.	Annalisa Bonfiglio, Danilo De Rossi, “Wearable Monitoring Systems”, Springer, 2011.
2.	Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability’’, Cambridge University Press, 2013.

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Reference Books	
1.	Hang, Yuan-Ting, “Wearable medical sensors andsystems”, Springer - 2013.
2.	Mehmet R. Yuce, Jamil Y. Khan, “Wireless Body Area Networks Technology, Implementation and Applications”, Pan Stanford Publishing Pvt. Ltd, Singapore, 2012.
3.	Guang-Zhong Yang (Ed.), "Body Sensor Networks”, Springer, 2006.
4.	Andreas Lymberis, Danilo de Rossi, “Wearable eHealth systems for Personalized Health Management - State of the art and future challenges”, IOS press, Netherlands, 2004.

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B.E. / B.Tech	B23BME903 – EXTENDED AND AUGMENTED REALITY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To learn the working principles of AR/VR-based training simulators.
2.	To gain knowledge in AR/VR technologies, content creation and hardware design
3.	To study health and safety issues.
4.	To understand awareness about recent trends in AR/VR systems
5.	To know the competency in VR and AR applications in medicine.

UNIT - I	VIRTUAL REALITY TECHNOLOGIES	9

Introduction to Virtual Reality (VR) – Types – current VR Technologies – Hardware and Software; Introduction to Augmented Reality (AR) – Types – Technologies – Hardware and Software – Developmental Tools; The three I's of virtual reality and the five classic components of a VR system; Motion tracking, navigation and controllers - Position and Motion Trackers - Inside Out / Outside In, Head Mounted Display.

UNIT - II	THE HUMAN BEHIND THE LENSES	9

Human Perception and Cognition - The Human Visual System - The Human Auditory System - The Human Vestibular System; Physiology, Psychology and the Human Experience - Adaptation and Artefacts - Ergonomics - Ethics - Scientific Concerns; VR - Health and Safety Issues - Effects of VR Simulations on Users - Cybersickness, before and now - Guidelines for Proper VR Usage; User Centered Design, User Experience and an Ethical Code of Conduct.

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UNIT - III	MODELING	9
Navigation and Manipulation Interfaces; Tracker Based Navigation/Manipulation Interfaces – Three - Dimensional Probes and Controllers - Data Gloves and Gesture Interfaces; Reality, Virtuality and Immersion - VR, AR, MR, xR : similarities and Differences, Current trends and state of the art in immersive technologies, developing platforms and consumer devices - Camera tracking and 3D Rendering for Immersive Environments; Modeling the Physical world – Geometric Modeling - Kinematics Modeling - Physical Modeling - Behavior Modeling - Model Management.		
UNIT - IV	**AR AND MR**	**9**
Definition; Tracking for Augmented Reality - Augmented Reality Interaction - Collaborative Augmented Reality - Heterogeneous user interfaces - Mobile Augmented Reality - Software Technologies, Augmented Reality Methods, 3D User Interface Input Hardware, Visualization Techniques.		
UNIT - V	**XR AND HEALTHCARE APPLICATIONS**	**9**
Virtual and Augmented Surgery - Virtual Anatomy - Post-Traumatic Stress Disorder (PTSD) with VR, VR for Disabled People, Pain Treatment with VR, Experiential Treatment with VR, Experiential Personal Development with VR; Methodology and terminology - user performance studies - VR health and safety issues - Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment; Behavioral Therapy - Exposure Therapy and PTSD – Training – Rehabilitation - Triage and Diagnostics.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Understand the working principles in AR/VR based training simulators.
CO2	Acquire the knowledge in AR/VR technologies content creation and hardware design.
CO3	Articulate health and safety issues.
CO4	Develop the awareness about recent trends in AR/VR systems.
CO5	Demonstrate the competency in VR and AR applications in medicine.

Text Books

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1.	C. Burdea& Philippe Coiffet, “Virtual Reality Technology”, Second Edition, Gregory, John Wiley & Sons, Inc., 2008.
2.	Kelly S. Hale (Editor), Kay M. Stanney (Editor), Handbook of Virtual Environments : Design, Implementation, and Applications, Second Edition (Human Factors and Ergonomics) ISBN-13 : 978-1466511842. Amazon, 2014
3.	Virtual and Augmented Reality : An Educational Handbook, Zeynep Tacgin, Cambridge Scholars Publishing, Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK, 2020.

Reference Books	
1.	Jason Jerald, The VR Book, Human-Centered Design for Virtual Reality, Jason Jerald, Next Gen Interactions, 2016.
2.	Pensieri Claudio & Pennacchini Maddalena, Overview : Virtual Reality in Medicine, Journal of Virtual Worlds Research, Volume 7, Number 1, Lantern (1), January, 2014.
3.	Mythreye Venkatesan & etal, Review : Virtual and augmented reality for biomedical applications, CellPress, Cell Reports Medicine 2, 100348, July 20, 2021.
4.	John Vince, “Introduction to Virtual Reality”, Springer-Verlag Ltd., 2004.

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B.E. / B.Tech	B23BME904 – TELEHEALTH TECHNOLOGY AND CYBERSECURITY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand telehealth technologies and their applications in healthcare.
2.	To familiarize students with legal and regulatory frameworks governing telehealth security, including HIPAA, HITECH, GDPR, and FDA regulations.
3.	To explore key cybersecurity measures for protecting telehealth data, focusing on encryption, authentication, block chain, and EHR security.
4.	To introduce best practices for securing telehealth systems, covering authentication mechanisms, risk management, vendor security, and software development.
5.	To examine emerging trends in telehealth cybersecurity, including AI-driven security, 5G implications, and ethical challenges.

UNIT - I	INTRODUCTION TO TELEHEALTH TECHNOLOGIES	9
Definition and scope of telehealth, Telemedicine vs. telehealth, Evolution and impact of telehealth Telehealth platforms and devices, Telehealth software and hardware components, Network requirements for telehealth services.		

UNIT - II	REGULATORY AND LEGAL CONSIDERATIONS	9
Health Insurance Portability and Accountability Act (HIPAA), Health Information Technology for Economic and Clinical Health (HITECH) Act, General Data Protection Regulation (GDPR), FDA and telehealth device regulations.		

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UNIT - III	TELEHEALTH DATA SECURITY AND PRIVACY	9
Data encryption and secure transmission, Authentication and access control in telehealth, Role of block chain in telehealth security, Secure Electronic Health Records (EHR) integration.		

UNIT - IV	EST PRACTICES FOR SECURING TELEHEALTH SYSTEMS	9
Multi-factor authentication (MFA) and role-based access control, Secure telehealth software development lifecycle, Vendor and third-party risk management, Training and awareness programs for healthcare professionals.		

UNIT - V	FUTURE TRENDS IN TELEHEALTH AND CYBERSECURITY	9
AI and machine learning in telehealth security, 5G and telehealth security implications, Ethical considerations in telehealth cybersecurity, Future challenges and solutions in securing telehealth systems.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the fundamental concepts of telehealth technologies and their role in modern healthcare.
CO2	Analyze the regulatory landscape of telehealth and ensure compliance with legal standards such as HIPAA, HITECH, and GDPR.
CO3	Evaluate cybersecurity risks in telehealth systems and implement effective data protection strategies.
CO4	Apply security best practices such as multi-factor authentication, secure software development, and third-party risk management to telehealth platforms.
CO5	Assess the impact of emerging technologies like AI, 5G, and blockchain on the security and evolution of telehealth services.

Program Coordinator

Approved by BOS Chairman

Text Books	
1.	Krishna Kumar & A. Govindarajan, Telemedicine and E-Health Technology, CRC Press, 2019
2.	R.S. Khandpur, Handbook of Biomedical Instrumentation, McGraw Hill, 2014.
3.	Brian T. Malec, Telemedicine : The Computer Transformation of Healthcare, Springer, 2020.

Reference Books	
1.	C. Peter Waegemann, From Telehealth to E-Health : The Unstoppable Rise of E-Health, HIMSS Publishing, 2017.
2.	Bernadette Howlett, Ellen Rogo, and Teresa Gabiola Shelton, Telehealth and Mobile Health – Jones & Bartlett Learning, 2021.
3.	Joseph Tan and Fay Cobb Payton, Handbook of Research on Emerging Perspectives in Healthcare Information Systems and Informatics, IGI Global, 2018.
4.	National Institute of Standards and Technology (NIST), Cybersecurity Framework for Healthcare, NIST Publications.
5.	T. Andrew Finn and Erin L. Parrott, Telehealth and Telemedicine : A Practical Guide for Implementation and Operation, CRC Press, 2021.

Program Coordinator

Approved by BOS Chairman

B.E. / B.Tech	B23BME905 – BIOMETRICS IN HEALTHCARE	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To learn about the basics of Biometrics.
2.	To study about the classification of Biometric system and its strength and weakness.
3.	To learn about the applications of biometrics in healthcare sector.
4.	To learn about security and privacy concerns of biometric system.
5.	To gain comprehensive knowledge on biometric system design for healthcare.

UNIT - I	INTRODUCTION TO BIOMETRICS	9
Introduction to Biometrics, Benefits of biometrics over traditional methods, Key biometric terms and processes, Verification, identification, and enrollment processes, Accuracy metrics: False Match Rate (FMR), False Non-Match Rate (FNMR), Equal Error Rate (EER).		

UNIT - II	BIOMETRIC MODALITIES	9
Physiological biometrics: Finger scan, facial scan, iris scan - components, working principles, strengths, and weaknesses. Behavioral biometrics : Signature scan, keystroke scan - components, working principles, strength and weakness applications of each modality.		

UNIT - III	BIOMETRIC APPLICATIONS	9
Biometric applications: Categorizing biometric applications, Criminal identification, Citizen identification, Surveillance, Customer facing applications, E-commerce/telephony, Retail/ ATM/point of sale applications. Biometric markets: Law enforcement, government sector, Financial sector, Healthcare, travel and immigration, Biometric standards.		

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UNIT - IV	BIOMETRIC SECURITY AND PRIVACY	9
Securing biometric transactions : Matching location, authentication server, match-on-card (MOC), Ethical considerations and privacy regulations, Biometric system vulnerabilities and circumvention.		

UNIT - V	BIOMETRIC SYSTEM DESIGN FOR HEALTHCARE	9
System design issues: Authentication protocols, template generation, and data storage, Security measures: Presentation Attack Detection (PAD), encryption, and interoperability.		
	Total Instructional hours : 45	

Course Outcomes : Students will be able to	
CO1	Summarize the benefits of biometrics over traditional identification methods in healthcare.
CO2	Compare and contrast different biometric modalities (e.g., fingerprint vs. iris recognition) based on their strengths and weaknesses.
CO3	Design a secure biometric system tailored for healthcare applications, incorporating privacy regulations and ethical considerations.
CO4	Analyze the effectiveness of biometric systems in enhancing security and usability in healthcare.
CO5	Apply end-to-end encryption to biometric data during capture, transmission, and storage in healthcare.

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Text Books	
1.	“Biometrics : Theory, Methods, and Applications” by N. V. Boulgouris, Konstantinos N. Plataniotis, and Evangelia Micheli-Tzanakou.
2.	“Handbook of Biometrics” edited by Anil K. Jain, Patrick Flynn, and Arun Ross.

Reference Books	
1.	“Biometric Security from an Information - Theoretical Perspective” by Tanya Ignatenko and Frans M.J. Willems.
2.	“Biometrics, Computer Security Systems, and Artificial Intelligence Applications” by Khalid Saeed and Jerzy Pejas.

Program Coordinator

Approved by BOS Chairman

B.E. / B.Tech	B23BME906 – COMPUTATIONAL NEUROSCIENCE	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To the review the basic fundamentals of probability theory for dynamical system.
2.	To provide understanding of principal concepts behind the working of neurons.
3.	To enhance knowledge on neural encoding and decoding process.
4.	To enable modeling of neurons and neural networks.
5.	To provide insights on simulation tools to analyze neural systems.

UNIT - I	INTRODUCTION	9
Review - Convolution - Linear systems - Vectors - Matrices - Basis vectors – Probability theory - Probability distribution - Bayes theorem - Dynamical systems.		

UNIT - II	WORKING OF NEURONS	9
Electrical nature of neurons - Synapses - Brain areas - Brain functions - Neuron spikes - Entropy – Spike train information - Brain noise.		

UNIT - III	NEURAL ENCODING AND DECODING PROCESS	9
Coding principles - Neural encoding - Feature selection - Variability - Neural decoding and signal detection theory - Population coding - Bayesian estimation - Reconstructing stimulus - Neuron models - Mechanistic and interpretive models.		

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UNIT - IV	NEURONS AND NEURAL NETWORKS	9
Spike train modelling - Hodgkin-Huxley model - Neural correlations - Synchrony – Synapses modelling - Firing rate models - Feed Forward Networks - Recurrent Networks – Synaptic plasticity - Statistical learning - Unsupervised learning - Sparse coding - Predictive coding Neurons as classifiers - Reinforcement Learning.		

UNIT - V	MODELING OF NEURONS AND NEURAL NETWORKS	9
Modeling Individual Neurons, Brain Organoid Models, Mathematical Models, Biophysical Characteristics, Realistic Modeling, Brain Simulation, Optimization Algorithms, Case study on modelling human brain function using Artificial Neural Networks.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Summarize the basic principles of cognitive neuroscience.
CO2	Apply information theory for neural encoding and decoding.
CO3	Analyze neural activity using computational models.
CO4	Evaluate performance of learning methodologies of neurons.
CO5	Analyze the various BAN applications.

Text Books	
1.	Dayan, P. and Abbott, L.F, Theoretical neuroscience : computational and mathematical modeling of neural systems, First Edition, MIT Press, 2001.
2.	Bielza, C. and Larrañaga, P, Data-Driven Computational Neuroscience : Machine Learning and Statistical Models, First Edition, Cambridge University Press, 2020

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Reference Books	
1.	Arbib, M.A. and Bonaiuto, J.J, From neuron to cognition via computational neuroscience, First Edition, MIT Press, 2016
2.	Miller P, An introductory course in Computational Neuroscience, First Edition, MIT Press, 2018

Program Coordinator

Approved by BOS Chairman

B.E./ B.Tech	BM23BME907 – VIRTUAL INSTRUMENTATION FOR MEDICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To provide knowledge of virtual instrumentation and its applications in medical systems.
2.	To explore various data acquisition methods and communication techniques used in biomedical applications.
3.	To provide knowledge of signal processing techniques for biomedical signal acquisition and enhancement.
4.	To understand the design principles of digital filters and their significance in frequency domain analysis.
5.	To study biomedical signal compression techniques and their real-world applications in medical data management.

UNIT - I	BASICS OF VIRTUAL INSTRUMENTATION	9
Introduction to virtual instrumentation - Loops and structures - Arrays and clusters - Graphs and charts - File and string handling.		

UNIT - II	DATA ACQUISITION AND COMMUNICATION	9
Basics of data acquisition - Common communication buses using DAQ assistant - Real-world DAQ and issues - Network and distributed systems.		

UNIT - III	SIGNAL ACQUISITION AND FILTERING	9
Data handling techniques - Signal acquisition and sampling theorem - Effect of under sampling - Convolution - Designing an FIR and IIR filters.		

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UNIT - IV	FREQUENCY ANALYSIS AND FILTER DESIGN	9
FFT analysis of periodic and aperiodic signals - Designing of low pass filter - High pass filter - Bandpass filter - Band reject filter - Notch filter and Comb filter.		

UNIT - V	BIOMEDICAL SIGNAL PROCESSING AND COMPRESSION	9
Processing of ECG, EMG, and EOG signals - Adaptive signal processing - Data compression techniques - AZTEC - TP - CORTES and KL transform.		
	Total Instructional hours : 45	

Course Outcomes : Students will be able to	
CO1	Explain the working principles of virtual instrumentation in medical systems.
CO2	Differentiate various data acquisition methods and their applications in biomedical systems.
CO3	Apply signal processing techniques for biomedical signal enhancement.
CO4	Explain the design principles of digital filters and their role in frequency analysis.
CO5	Apply biomedical signal compression techniques for real-world medical applications.

Text Books	
1.	Sanjay Gupta and Joseph John, Virtual Instrumentation Using Labview, Tata McGraw Hill Education Private Limited, 2010.

Reference Books	
1.	Behzad Ehsani, Data Acquisition using LabVIEW, Packt Publishing, 2016.

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2.	Kunal Mitra, Stephanie Miller, Short Pulse Laser Systems for Biomedical Applications, Springer Briefs in Applied Sciences and Technology, 2017.
3.	Leon Goldman, The Biomedical Laser Technology and Clinical Applications, Springer Verlag, 1981.

Program Coordinator

Approved by BOS Chairman

Vertical 2

Program Coordinator	Approved by BOS Chairman

B.E. / B.Tech	B23BME908 – CLINICAL CARE EQUIPMENT	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To offer clear understanding of various intensive care equipment and their working.
2.	To understand the necessity of different operation theatre equipment.
3.	To learn the different types of clinical care equipment.
4.	To know about different dialyzers and ventilators.
5.	To study about patient safety and centralized system.

UNIT - I	INTENSIVE CARE UNIT EQUIPMENT	9
Suction apparatus, Different types; Sterilizers, Chemical, Radiation, steam for small and large units. ICU Ventilators. Augmented drug delivery systems, Infusion pumps, components of drug infusion system, closed loop control infusion system, implantable infusion system. BMD Measurements – SXA – DXA – Quantitative ultrasound bone densitometer.		

UNIT - II	CRITICAL CARE EQUIPMENT	9
Defibrillators, Hemodialysis Machine, Different types of Dialyzers, Membranes, Machine controls and measurements. Heart Lung machine, different types of oxygenerators, peristaltics pumps and Incubators.		

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UNIT - III	OPERATION THEATRE EQUIPMENT	9
Craniotomy, Electrosurgical Machines(ESU), electrosurgical analyzers, surgical aspirator, Instruments for operation. Anesthesia Machine, Humidification, Sterilization aspects, Boyles apparatus. Endoscopy – Laproscopy – Cryogenic equipment – Anesthesia gas, Anesthesia gas monitor, surgical microscope.		

UNIT - IV	CENTRALISED SYSTEMS	9
Centralized oxygen, Nitrogen, Air supply & Suction. Centralized Air Conditioning, Operation Theatre table & Lighting. C Arm.		

UNIT - V	PATIENT SAFETY	9
Patient Electrical safety, Types of hazards, Natural protective mechanisms against electricity, Leakage current, Inspection of grounding and patient isolation, hazards in operation rooms, ICCU and IMCUs, Opto couplers and Pulse transformers.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Apply the knowledge acquired , in designing new monitoring devices for ICU and assist the medical personnel's during emergency situations.
CO2	Select suitable surgical instruments and operational devices.
CO3	Compare the various techniques for clinical diagnosis, theraphy and surgery, and it's recent methods.
CO4	Assess the merits of the operation theatre equipment based on its applications.
CO5	Design the devices for the particular application based on given specifications.

Text Books

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Approved by BOS Chairman

1.	John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
2.	Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson education, 2012

Reference Books	
1.	R S Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, 2003.
2.	John Enderle, Joseph D. Bronzino, Susan M. Blanchard, “Introduction to Biomedical Engineering”, Elsevier, 2005.
3.	L.A Geddes and L.E. Baker, “Principles of Applied Biomedical Instrumentation”, 3rd Edition, 2008.
4.	Anatomy Y.K. Chan,”Biomedical Device Technology, Principles and design”, Charles Thomas Publisher Ltd, Illinois, USA, 2008.
5.	Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Pearson Education, New Delhi, 2007.

Program Coordinator

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B.E. / B.Tech	B23BME909 ADVANCED HEALTHCARE TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To Understand the needs for wearable devices and the technology.
2.	To Learn the concepts in digital health care and digital hospitals.
3.	To Apply the tools in design, testing and developing digital health care equipment.
4.	To study M-healthcare and wearable devices.
5.	To know various standards for inter – operability of devices, quality and safety standards for developing healthcare systems.

UNIT - I	DIGITAL HEALTH	9
Requirements and best practices, Laws and regulations in Digital health, Ethical issues, barriers and strategies for innovation.		

UNIT - II	DIGITAL RADIOLOGY	9
Digital Radiology for digital hospital, picture archiving and communication, system integration, digital history of radiology, medical image archives, storage and networks.		

UNIT - III	E - HEALTH	9
Health care networking, medical reporting using speech recognition, physiological tests and functional sis with digital methods, tele-consultation in medicine and radiology.		

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UNIT - IV	M – HEALTHCARE AND WEARABLE DEVICES	9
Introduction to Mobile healthcare devices-economy-average length of stay in hospital, outpatient care, healthcare costs, mobile phones, 4G, smart devices, wearable devices, Uptake of e – health and m – health technologies. Standards, system design and case study.		

UNIT - V	MODALITY AND STANDARDS FOR INTER - OPERABILITY	9
Multimodality registration in daily clinical practice, Mobile healthcare, selection and implementation in e – health project, design of medical equipment based on user needs, security and privacy in digital healthcare, Case study.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Interpret the need for digital methods of handling medical records.
CO2	Explain the digital radiology.
CO3	Modify the tools and methods for work flow in E – health.
CO4	Identify the available technology for wearable healthcare devices.
CO5	Compare various standards for inter – operability of devices, quality and safety standards for developing healthcare systems.

Text Books

Program Coordinator

Approved by BOS Chairman

1.	Christoph Thuemmler, Chunxue Bai, “Health 4.0 : How Virtualization and Big data are Revolutionizing Healthcare”, Springer, 1st ed.2017
2.	Wlater Hruby, “Digital revolution in radiology – Bridging the future of health care”, second edition, Springer, New York, 2006.

Reference Books	
1.	Samuel A. Fricker, Christoph Thummler, Anastasius Gavras, “Requirements Engineering for Digital ealth”, Springer, 2015.
2.	Rick Krohn (Editor), David Metcalf, Patricia Salber, “Health -e Everything: Wearables and the Internet of things for health”, ebook. 2013.
3.	Khandpur R.S, “Handbook of Biomedical Instrumentation”, Second Edition. Tata Mc Graw Hill Pub. Co., Ltd. 2003
4.	John, G. Webster, “Medical Instrumentation: Application and Design”, Second Edition. Wiley Publisher, New Delhi. 2013.

Program Coordinator

Approved by BOS Chairman

B.E. / B.Tech	B23BME910 – ROBOTICS IN MEDICINE	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the fundamental principles and technologies underlying medical robotics..
2.	To explore the design and application of robotic systems in surgery, diagnostics, rehabilitation and patient care.
3.	To understand the integration of robotics with medical imaging and Artificial Intelligence.
4.	To provide more exposure to robotic platforms and simulation tools used in healthcare.
5.	To examine real-world case studies of robotic interventions in clinical settings.

UNIT - I	INTRODUCTION	9
Introduction Automation and Robots, Classification, Application, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation – Five-axis robot, Four-axis robot, Six-axis robot.		

UNIT - II	KINEMATICS	9
Inverse Kinematics – General properties of solutions tool configuration, Five axis robots, Three - Four axis, Six axis Robot, Workspace analysis and trajectory planning work envelope and examples, workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.		

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UNIT - III	ROBOT VISION	9
Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation – Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration.		
UNIT - IV	**PLANNING**	**9**
Task Planning Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.		
UNIT - V	**APPLICATIONS**	**9**
Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynecology, Orthopaedics, Neurosurgery.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Recall the fundamental principles and components of medical robotic systems.
CO2	Describe the use of robotics in various medical applications such as surgery, diagnostics and rehabilitation.
CO3	Apply the concepts of robotic integration with imaging systems and artificial intelligence in medical contexts.
CO4	Analyze the use of robotic platforms and simulation tools in healthcare.
CO5	Evaluate the case studies to identify benefits, limitations and effectiveness of robotic interventions in clinical practice

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Text Books	
1.	Robert Schilling, “Fundamentals of Robotics-Analysis and control”, Prentice Hall, 2003.
2.	J.J. Craig, “Introduction to Robotics”, Pearson Education, 2005.

Reference Books	
1.	Staugaard, Andrew C,“Robotics and Artificial Intelligence : An Introduction to Applied Machine Learning”, Prentice Hall Of India, 1987.
2.	Grover, Wiess, Nagel, Oderey, “Industrial Robotics : Technology, Programming and Applications”, McGraw Hill, 1986.
3.	Wolfram Stadler, “Analytical Robotics and Mechatronics”, McGraw Hill, 1995.
4.	Saeed B. Niku, “Introduction to Robotics: Analysis, Systems, Applications”, Prentice Hall, 001.
5.	K.S. Fu, R.C. Gonzales and C.S.G. Lee, “Robotics”, McGraw Hill, 2008.

Program Coordinator

Approved by BOS Chairman

B.E. / B.Tech	B23BME911 - ADVANCED THERAPEUTIC EQUIPMENT	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study about the microscopy
2.	To learn about the hybrid techniques and types of chromatography
3.	To study special techniques in advanced bio analytical.
4.	To learn the radiation therapy and radiation safety.
5.	To analysis about the basics of respiratory aids

UNIT - I	ADVANCED IMAGING TECHNIQUES IN MICROSCOPY	9

Live cell imaging, Confocal microscopy and sample preparation for fluorescence microscopy - High content/throughput screening - Basics of SEM & Specin1en preparation for SEM - Basics of TEM & Specimen preparation for TEM. Advanced EM techniques: Electron tomography and Serial block face imaging using SEM - CryoEM - Methods to study STED - Structured Illumination Microscopy.

UNIT - II	ANALYTICAL HYBRID TECHNIQUES	9

Gas chromatography with mass spectrometric detection (GC-MS). liquid chrorith mass spectrometric detection (LC-MS), inductively coupled plasma with mass Spectrometric detection (lCP-MS). Metal analysis by lCP-MS; Analysis of data : HPLC chromatograms, including trouble shooting- how to achieve good separation on l--TPLC; GC-MS data; LC-MS spectra.

UNIT - III	ANALYTICAL SPECIAL TECHNIQUES	9

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Flow Cytometer: Introduction to flow cytometry - Fluorochromes and fluorescence - Experimental design and fluorescence quantitation Compensation and gating - Normalization - Comparing Univariate Cell Distributions - Probability Binning - Readings on flow cytometry data analysis. isoelectric focusing and 2-Dimensional polyacrylamide gel electrophoresis and their uses in protein research. Protein crystallization; Theory and methods.

UNIT - IV	BODY CARE EQUIPMENT	9
Skin Treatment: Ultrasonic spot remover, vacuum therapy unit, Skin tightening, Wrinkle Reduction, Facial and Rejuvenation. Laser hair therapy machine. Body Slimmer/Shaper – Deep Heat Therapy, Massager, Fitness – Treadmill, Bike.		

UNIT - V	DENTAL CARE EQUIPMENT	9
Dental Chair - Dental Hand pieces and Accessories : Evolution of rotary equipment, Low-speed handpiece, High-speed handpiece, Hand piece maintenance. Vacuum and Pneumatic techniques: Vacuum techniques, Oral evacuation systems, Vacuum pump, Pneumatic techniques, Dental compressor. Decontamination Unit and constant fumigation unit. Dental Radiography : Dental X-ray Machine.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain about the imaging techniques in micro copy.
CO2	Classify the analytical hybrid techniques in advanced bio analytical.
CO3	Compare the various types of special techniques.
CO4	Identify various body care equipment.
CO5	Categorize the various dental care equipment.

Text Books

Program Coordinator	Approved by BOS Chairman

1.	Khandpur. R.S., "Handbook of Biomedical Instrumentation", Second Edition, Tata McGrawHill Pub. Co., Ltd. 2003.
2.	Skoog, D.A., Crouch, S.R., and Holler, F.J, Principles of Instrumental Analysis, 6th edition Brooks/Cole USA 2006.

Reference Books	
1.	Leslie Cromwell, Fred. J. Weibell & Erich. A. Pfeiffer. "Biomedical Instrumentation and Measurements", Second Edition, Prentice Hall Inc. 2000.
2.	Albert M.Cook and Webster.J.G, "Therapeutic Medical Devices", Prentice hall Inc, New Jersy, 1982.
3.	Joseph. J. Carr, John Michael Brown, "Introduction to Biomedical Equipment Technology",Prentice Hall and Technology, 2008.
4.	Rangaraj. M. Rangayyan, "Biomedical Signal Analysis-A Case Study Approach", IEEE Press-John Wiley & Sons Inc, New York, 2002.

		L	T	P	C

Program Coordinator

Approved by BOS Chairman

B.E. / B.Tech	B23BME912 – SPORTS ENGINEERING AND TECHNOLOGY	3	0	0	3

Course Objectives	
1.	To understand the basic foundation in sports engineering and technology
2.	To explain the principle of mechanics in sports
3.	To learn the different materials and measurements in evaluating the activities in sports
4.	To analyze the various training and assessment in sports.
5.	To analyze the disabilities happened in sports and rehabilitation methods.

UNIT - I	INTRODUCTION TO SPORTS ENGINEERING AND TECHNOLOGY	9

Meaning of sports engineering, human motion detection and recording, human performance, assessment, equipment and facility designing and sports related instrumentation and measurement; Historic overview of sports equipment Sports Technology - Purpose and advantages of sports technology - Application of technology in modern sports. Purpose of instrumentation in sports.

UNIT - II	MECHANICS OF ENGINEERING IN SPORTS	9

Concept of internal force, axial force, shear force, bending movement, torsion, energy method to find displacement of structure, strain energy. Biomechanics of daily and common activities –Gait, Posture, Body levers, ergonomics; Mechanical principles in movements –as lifting, walking, running, throwing, jumping, pulling, pushing etc. A report on the impact of 3D Prosthetics in sports

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UNIT - III	MATERIALS AND PERFORMANCE ANALYSIS OF SPORTS	9
Measurement of surface performance, materials used in sports, Running shoe materials - construction and stress analysis; Playfields; Modern surface of playfields and its advantages. Types of materials of different play fields; - Synthetic, Wooden, polyurethane and Astroturf. Modern sports equipment, types, Materials and advantages, Significance of footwear in individual events. Clothing; - Types, Materials and advantages of clothing in different events. Modern measuring equipment in sports; - Running, Throwing and Jumping. Protective Equipment in sports and its advantage.		

UNIT - IV	MEASUREMENT, TRAINING AND ASSESSMENT IN SPORTS	9
Motion analysis using video: Analysis Software - Data Collection Procedure – Two Dimensional Video Re – recording - Three Dimensional Video Recording – Processing Analysis and Presenting Data; Sports Specific Instrumentation and software i.e. Athletic etc. Training Gadgets; Concept and use of modern training gadgets (Basketball- Ball Feeder, Cricket - Bowling Machine, Tennis - Serving Machine, Volleyball - Serving Machine, Table Tennis - Serving Machine; Use of Computer and Software in Match Analysis and Coaching. A case study on the role of AI and Data Analytics in Cricket.		

UNIT - V	IoT AND ASSISTIVE TECHNOLOGY IN SPORTS	9
Rehabilitation and Reintegration; IoT in Sports Analytics; Sports and Disability – Disabled Sports Equipment / Assistive Technology - wheelchairs – prosthetics - sportswear – sports for children with disabilities; Wearable Sensors in Sports for Persons with Disability; Immersive Technologies in Physical Education for Students with Learning Disabilities; 3D printing and parasports; IoT in smart footwear, smart apparel, smart equipment.		
		Total Instructional hours : 45

Program Coordinator	**Approved by BOS Chairman**

Course Outcomes : Students will be able to	
CO1	Define the importance of engineering and Technology in the sports.
CO2	Exhibit competency in the choice of materials that can augment performance.
CO3	Understand role of engineering biomechanics in sports.
CO4	Analyze the material concept of shoe, sports goods and instrumentation in Sports.
CO5	Apply the knowledge of Engineering and Technology in Sports Disability.

Text Books	
1.	Franz K.F. et. al., Editor, Routledge Handbook of Sports Technology and Engineering (Routledge, 2013)
2.	Steve Hake, Editor, The Engineering of Sport (CRC Press, 1996)
3.	Franz K.F. et. al., Editor The Impact of Technology on Sports II (CRC Press, 2007)

Reference Books	
1.	Helge N., Sports Aerodynamics (Springer Science & Business Media, 2009).
2.	Youlin Hong, Editor Routledge Handbook of Ergonomics in Sport and Exercise (Routledge, 2013).
3.	Jenkins M., Editor Materials in Sports Equipment, Volume I (Elsevier, 2003).
4.	Colin White, Projectile Dynamics in Sport: Principles and Applications.
5.	Eric C. et al., Editor Sports Facility Operations Management (Routledge, 2010).

Program Coordinator	**Approved by BOS Chairman**

B.E. / B.Tech	B23BME913 – COGNITIVE TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To learn the design of various neural networks.
2.	To familiarize with the design of various fuzzy logic.
3.	To Learn the various soft computing frameworks.
4.	To Learn genetic programming and hybrid systems.
5.	To learn computing techniques for biomedical applications.

UNIT - I	TYPES OF NEURAL NETWORKS	9

BPN, RBF, TDNN - associative memory network: auto-associative memory network, hetero - associative memory network, BAM, hopfield networks, iterative auto associative memory network & iterative associative memory network – unsupervised learning networks: Kohonenself organizing feature maps, LVQ – CP networks, ART network. Case studies on biomedical applications.

UNIT - II	FUZZY LOGIC	9

Membership functions: features, fuzzification, methods of membership value assignments- Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle – fuzzy measures - formation of rules-decomposition of rules, fuzzy inference systems - overview of fuzzy expert system - fuzzy decision making. Case studies on biomedical applications.

UNIT - III	GENETIC ALGORITHM	9

Genetic algorithm and search space - general genetic algorithm, operators - Generational cycle, stopping condition, constraints. Classification, genetic programming, multilevel optimization, real life problem, Advances in GA. Case studies on biomedical applications using deep learning.

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UNIT - IV	HYBRID SOFT COMPUTING TECHNIQUES	9
Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems - simplified fuzzy ARTMAP. Case studies on biomedical applications.		

UNIT - V	APPLICATIONS	9
A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers. Case studies on biomedical applications.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Identify various soft computing frame works.
CO2	Interpret various neural networks and fuzzy logic methods.
CO3	Relate genetic programming and hybrid soft computing.
CO4	Assess hybrid techniques.
CO5	Select computing techniques for biomedical applications.

Text Books	
1.	The ICU Book – Paul L Marino (Lippincott, Williams & Wilkins)
2.	Geddes and Bakar, “Principles of Applied Biomedical Instrumentation”, John Wiley and Sons Inc., New York, 1968.

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Reference Books	
1.	“Medical Devices : A Practical Guide”, by Prakash Srinivasan and Timiri Shanmugam
2.	R.S. Khandapur, “Hand Book of Biomedical Instrumentation”, Tata McGraw Hill Publishers, New Delhi,1990.

Program Coordinator

Approved by BOS Chairman

B.E. / B.Tech	B23BME914 – MEDICAL TECHNOLOGY AND EVALUATION	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Understanding the principles and methodologies of medical technology assessment.
2.	Learn various clinical traits of Knowledge of various medical technologies.
3.	To carry out ethical considerations of medical technology.
4.	To compile the economic aspects of medical technology.
5.	To explore data exchange and integration across different healthcare systems.

UNIT - I	FUNDAMENTALS OF MEDICAL TECHNOLOGY	9
Introduction to Medical Technology - Health Care Financing - Regulatory Environment - Health Care Financing - Regulatory Environment - Clinical Trials - Insurance Claims Data - The Elements of Medical Technology Assessments - Methodological Approaches and Considerations.		

UNIT - II	CLINICAL TRIALS	9
Definition - Phases - Types - Roles and responsibilities - Good Clinical Practice (GCP) principles Informed consent, risk - benefit assessment - Stakeholders in Clinical Trials - Sponsors investigators, IRBs, participants Roles and responsibilities.		

UNIT - III	MEDICAL TECHNOLOGY ASSESSMENT	9
Health Problem - Technical Characteristics - Safety - Clinical Effectiveness - Costs, Economic Evaluation - Ethical Analysis - Organizational Aspects - Patient and Societal Aspects - Systematic Evaluation - Decision - Making.		

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UNIT - IV	METHODOLOGICAL APPROACHES AND CONSIDERATIONS	9
Learning Curve Effects - Stakeholder Involvement - Ethical Considerations - Economic risk - Data Collection and Analysis - Method of Validation - Standardization - Method Optimization - Interdisciplinary Approach - Policy Mechanisms.		

UNIT - V	HEALTHCARE INTEROPERABILITY	9
Interoperability - standards - levels of interoperability - data sharing - Clinical Documentation Architecture (CCDA), Clinical Decision Support (CDS), harmonisation between interoperability standards.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Learn the underlying principles and physics behind medical technologies.
CO2	Apply knowledge to real-world clinical scenarios and understanding different technologies for diagnosis, treatment, and monitoring.
CO3	Understand how to convert HTA findings into procurement and implementation needs.
CO4	Evaluate information systems and applications, ensuring confidentiality, security, and integrity.
CO5	Understanding of relevant regulations and policies related to healthcare interoperability.

Text Books	
1.	Handbook of Medical and Healthcare Technologies, Borko Furht, Ankur Agarwal.
2.	Modern Methods of Clinical Investigation, Annetine C. Gelijns, Committee on Technological Innovation in Medicine, 1990.
3.	Healthcare Technology Management Systems, Rossana Rivas, Luis Vilcahuamán, 2017.

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Reference Books	
1.	Health Technology Assessment and Health Policy Today : A Multifaceted View of Their Unstable Crossroads, ISBN : 9783319150048, 3319150049, 8 January 2015.
2.	Methods for the Economic Evaluation of Health Care Programmes, M.F. Drummond, G.L. Stoddart, George W. Torrance, Oxford University Press.

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Vertical - 4

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B.E. / B.Tech	B23BME915 – NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To provide a broad view of the growing field of nanoscience and nanotechnology to undergraduates.
2.	To explore the basics of nanomaterial synthesis and characterization.
3.	To understand the properties of nanomaterials.
4.	To explore the various types of nanostructures.
5.	To introduce the applications of nanotechnology.

UNIT - I	INTRODUCTION TO NANOTECHNOLOGY	9
Basic Structure of Nanoparticles - Kinetics in Nanostructured Materials - Zero dimensional, size and shape of nanoparticles; one-dimensional and two dimensional nanostructures - clusters of metals and semiconductors, bionano-particles.		

UNIT - II	FABRICATION AND CHARACTERIZATION OF NANOMATERIALS	9
Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes); Gas, liquid, and solid – phase synthesis of nanomaterials; Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials.		

UNIT - III	PROPERTIES AND MEASUREMENT OF NANOMATERIALS	9
Optical Properties : Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.		

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UNIT - IV	NANO STRUCTURES	9
Carbon Nanotubes, Fullerenes, Nanowires, Quantum Dots. Applications of nanostructures. Reinforcement in Ceramics, Drug delivery, Giant magnetoresistance, etc. Cells response to Nanostructures.		

UNIT - V	APPLICATIONS OF NANOTECHNOLOGY	9
Nano electronics, Nanosensors, Nanotechnology in Tissue Engineering, Application of Nanotechnology in Cancer Diagnosis and Therapy, Nanotechnology in Diagnostics applications, Nano Biosensor, Environmental Applications of nanotechnology.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the basic science behind the properties of materials.
CO2	Interpret characterization and manipulation of nanoscale materials.
CO3	Illustrate the various properties of nanomaterials.
CO4	Explain the various types of nanostructures.
CO5	Illustrate the various applications of nanotechnology in biomedical engineering.

Text Books	
1.	Springer Handbook of Nanotechnology by Bharat Bhushan 2004. (Unit I – V)
2.	Encyclopedia of Nanotechnology - Hari Singh Nalwa 2004. (Unit I – V)

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Reference Books	
1.	Nanomaterials, Nanotechnologies and Design : an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth - Heinemann, 2009.
2.	Handbook of Nanophase and Nanostructured Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic / Plenum Publishers, 2003.
3.	Handbook of Nanoceramics and their Based Nanodevices (Vol. 2) Edited by Tseung - Yuen Tseng and Hari Singh Nalwa, American Scientific Publishers.

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B.E. / B.Tech	B23BME916 – ASSISTIVE TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To gain knowledge, skills and application of existing technology.
2.	To understand innovative and indigenous technologies to enhance the quality of life.
3.	To gain knowledge on assistive technologies.
4.	To demonstrate Software applications for persons with special needs.
5.	To know how ICT can be a potential solution for people with special.

UNIT - I	ASSISTIVE TECHNOLOGY FOR CARDIAC IMPAIRMENT	9
Principle of External counter pulsation techniques, intra-aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle.		

UNIT - II	ASSISTIVE TECHNOLOGY FOR VISUAL IMPAIRMENT	9
Types of visual impairment, color blindness, corrective lenses, haptic as a substitute for vision, Mobility : canes- types, Guided Dog, Navigation - GPS.		

UNIT - III	ASSISTIVE TECHNOLOGY FOR HEARING IMPAIRMENT	9
Technology for non-aided users, Technology for aided users, telephone accessories, music ccessories, assistive listening system, Alerting devices, TTY relay services.		

UNIT - IV	ASSISTIVE TECHNOLOGY FOR PHYSICAL IMPAIRMENT	9
Alternative input devises to access computers, Eye gaze system, head tracking system, foot control system, Technology for daily living – wheel chairs types.		

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UNIT - V	COGINITIVE TECHNOLOGY	9
Human cognitive - assistive technology for learning disabilities, intellectual disability, speech and language disorders.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Acquire knowledge, skills and application of existing technology.
CO2	Design innovative and indigenous technologies to enhance the quality of life.
CO3	Build knowledge on Assistive devices and assistive technologies.
CO4	Develop Software applications for persons with special needs.
CO5	Understanding how ICT can be a potential solution for people with special.

Text Books	
1.	Marion. A. Hersh, Michael A. Johnson, "Assistive Technology for visually impaired and blind, Springer Science & Business Media", 1st edition, 12 May 2010.
2.	Suzanne Robitaille - The Illustrated Guide to Assistive Technology and Devices Tools and Gadgets for Living Independently (2010)
3.	Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph. D, Bronzino, Clinical Engineering, CRC Press, 1st Fedition, 2010.

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Reference Books	
1.	Kenneth J. Turner Advances in Home Care Technologies : Results of the match Project, Springer, 1st edition, 2011. 2.
2.	Gerr M. Craddock Assistive Technology-Shaping the future, IOS Press, 1st edition, 2003.
3.	Soonhwa Seok - Handbook of Research on Human Cognition and Assistive Technology Design, Accessibility and Transdisciplinary Perspectives (Handbook of Research On...) Medical Information Science Refer.

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B.E. / B.Tech	B23BME917 – PATIENT SAFETY STANDARDS AND ETHICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the importance of patient safety against electrical hazards.
2.	To explain the patient safety laws and regulations.
3.	To understand the standards and testing of patient.
4.	To know the patient safety specialties in clinical.
5.	To know about the health care organization ethics, legal aspects and regulatory affairs.

UNIT - I	EFFECTS OF ELECTRICITY	9
Physiological effects of electricity - important susceptibility parameters – medical analysis of electric shocks and its effects, shocks due to flash / Spark over's, prevention of shocks, safety precautions against contact shocks		

UNIT - II	PATIENT SAFETY : AN ORGANIZATIONAL FUNCTION	9
Anatomy of a patient safety Law : Compliance Tips, Federal patient safety Legislation Initiatives, Patient safety Goals and standards - Safety cultures - Healthcare associated infections - Risk factors of adverse drug events - rapid response systems.		
UNIT - III	**STANDARDS AND TESTING**	**9**
Guidelines and safety practices to improve patient safety, Electrical safety codes and standards - IEC 60601-2005 standard, Basic Approaches to protection against shock, protection equipment design, Electrical safety analyser - Testing the electric system, establishing quality assurance committee, clinical audit - establishing criteria for diagnosis, Investigations and treatment.		

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UNIT - IV	PATIENT SAFETY AND RADIATION AREA SAFETY	9
Intensive care and Anesthesiology, safety surgery save lives, Emergency department clinical risk, Obstetric safety patient, Patient safety in internal medicine, Patient safety in Radiology. OSHA ionizing radiation standards, caution signs, radiation safety committee, Radioactive waste management, safety recommendations for non-ionizing radiations in healthcare facilities.		
UNIT - V	**MEDICAL ETHICS, LEGAL ASPECTS AND REGULATORY AFFAIRS**	**9**
Definition of Medical ethics, American medical Association code of ethics, CMA code of ethics - Fundamental Responsibilities, The Doctor and the Patient, The Doctor and The Profession, Medical / Professional acts, hospital responsibilities - Medical indemnity insurance against malpractice suits. Medical regulatory affairs : Introduction to Regulatory Affairs, Regulatory Bodies and Agencies, Medical Device Registration, Quality assurance and Management Systems, International Regulatory Frameworks, International Medical Device Regulators Forum (IMDRF). Inspection of medical device and IVD establishments, Import and export of medical devices and IVDs.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Outline the importance of patient safety against electrical hazards.
CO2	Implement the concept of the patient safety specialties in clinical.
CO3	Explain the standards and testing of patient.
CO4	Identify the patient safety laws and regulations.
CO5	Explain about various health care organization acts, code of ethics and regulatory affairs on medical devices.

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Text Books	
1.	John G. Webster, "Medical Instrumentation Application and design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
2.	Liam Donaldson, Walter Ricciardi, "Textbook of patient safety and clinical Risk management", Springer.
3.	Fay A. Rozovsky, James R. Woods, Jr, "The Handbook of Patient Safety Compliance", 2016

Reference Books	
1.	Sharon Myers, "Patient Safety & Hospital Accreditation - A Model for Ensuring Success", Springer Publishers, 1st edition, 2012.
2.	Donaldson, Liam, Walter Ricciardi, Susan Sheridan, and Riccardo Tartaglia, "Textbook of patient safety and clinical risk management", Springer Nature, 1st edition, 2021.
3.	Ramakrishna, Seeram, Lingling Tian, Charlene Wang, Susan Liao, and Wee Eong Teo, "Medical devices : regulations, standards and practices", Woodhead Publishing, 1st edition, 2015.
4.	Vincent, Charles, "Patient safety", John Wiley & Sons, 1st edition, 2011.

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B.E. / B.Tech	B23BME918 – OCCUPATIONAL SAFETY AND HIPPA	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To provide exposure to the students about International Standard Act, safety and health care.
2.	Investigate current occupational safety and health problems and solutions.
3.	Identify the forces that influence occupational safety and health.
4.	Demonstrate the knowledge and skills needed to identify work place problems and safe work practice.
5.	Learn effective strategies for ensuring HIPAA compliance.

UNIT - I	INTERNATIONAL ACTS AND STANDARDS	9

Occupational Safety and Health act of USA (The Williames - Steiger Act of 1970) – Health and safety work act (HASAWA 1974, UK) – ISO 14001 – ISO 45001, European Safety and Health Legislations, American Petroleum Institute (API) Standards, Oil Industry Safety Directorate (OISD) Standards, National Fire Protection Association (NFPA) Standards, Atomic Energy Regulatory Board (AERB), American National Standards Institute(ANSI).

UNIT - II	ERGONOMICS AT WORK PLACE	9

Ergonomics Task analysis, Preventing Ergonomic Hazards, Work space. Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs. Hazard cognition and Analysis, Human Error Analysis – Fault Tree Analysis – Emergency Response - Decision for action – purpose and considerations. Indoor Air Quality: Asbestos Awareness - Blood-borne Pathogen.

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UNIT - III	HEALTH CONSIDERATIONS AT WORK PLACE	9
Types of diseases and their spread, Health Emergency. Principles of Personal Protective Equipment / Clothing, types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste. Environment management plans (EMP) for safety and sustainability. Forklift Safety / Heat Stress / Ladder Safety / Scaffold Safety.		

UNIT - IV	OCCUPATIONAL HEALTH AND SAFETY CONSIDERATIONS	9
Water and wastewater treatment plants, Handling of chemical and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing industries like cement plants, RMC Plants, precast plants and construction sites. Policies, roles and responsibilities of workers, managers and supervisors.		

UNIT - V	HEALTH INSURANCE PORTABILITY AND ACCOUNTABILITY ACT (HIPAA)	9
Omnibus Rule (2013) Components of Protected-Health Information (PHI) Difference between confidentiality, privacy, and security of patient data, Understanding Confidentiality and Privacy and Security Rule Patient's Rights under HIPAA Uses and Disclosure of Health Information.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to

CO1	List out important legislations related to health, Safety and Environment.
CO2	Understand the fundamentals of ergonomics.
CO3	Identify various types of hazards arising out of physical, chemical and biological agents in the safety process.
CO4	Understand the functions and activities of Occupational health services.
CO5	Identify notifiable occupational diseases arising out of Occupation and suggest methods for the prevention of such diseases.

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Text Books	
1.	Hand book of “Occupational Safety and Health”, National Safety Council, Chicago, 2002.
2.	Benjamin O.Alli, “Fundamental Principles of Occupational Health and Safety”, ILO 2008.

Reference Books	
1.	Bridger, RS : Introduction to Ergonomics, 2nd Edition, Taylor & Francis, 2003.
2.	Srinivasan S, “The Tamil Nadu Safety Officers Rules 2005”, Madras Book Agency, Chennai, 28th Edition, 2017
3.	“Encyclopedia of occupational safety and health”, ILO Publication, 1985

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B.E. / B.Tech	B23BME919 – HOSPITAL ADMIN AND WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To gain Knowledge about various biomedical management and handling rules.
2.	To learn the treatment and disposable techniques used for biomedical management.
3.	To understand the necessity of Biomedical waste Management in Hospitals.
4.	TolLearn the facility guidelines, infection control and patient safety.
5.	To teach biomedical waste management rules.

UNIT - I	HOSPITAL STANDARDS AND DESIGN	9

Definition of hospital – classification of hospitals – changing role of hospitals – role of hospital administrator – hospital as a system – hospital & community. Principles of planning – regionalization - hospital planning team – planning process – size of the hospital – site selection – hospital architect – architect report – equipping a hospital – interiors & graphics – construction & commissioning – planning for preventing injuries – electrical safety General standards – Mechanical standards – Electrical standards – standard for centralized medical gas system – standards for biomedical waste.

UNIT - II	HEALTHCARE HAZARD CONTROL	9

Healthcare Hazard Control : Introduction, Hazard Control, Hazard Control Management, Addressing Behaviors, Hazard Control Practice, Understanding Hazards, Hazard Analysis, Personal Protective Equipment, Accident Causation Theories, Human Factors, Accident Deviation Models, Accident Reporting, Accident Investigations, Accident Analysis, Organizational Functions That Support Accident Prevention, Workers' Compensation, Orientation, Education, and Training.

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UNIT - III	BIOMEDICAL WASTE MANAGEMENT	9
Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling, collection, storage and transportation, treatment and disposal.		

UNIT - IV	FACILITY AND SAFETY	9
Introduction, Facility Guidelines: Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Tool Safety, Electrical Safety, Control of Hazardous Energy, Landscape and Ground Maintenance, Fleet and Vehicle Safety.		

UNIT - V	INFECTION CONTROL AND PREVENTION	9
Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Blood borne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Medical Waste. Patient Safety: An Organizational Function, Errors and Adverse Events, Safety Cultures, Patient-Centered Healthcare, Quality Improvement Tools and Strategies, Healthcare-Associated Infections, Medication Safety.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Understand how to manage biomedical waste.
CO2	Know various biomedical management and handling rules.
CO3	Learn the treatment and disposable techniques of biomedical management.
CO4	Design different safety facility in hospitals.
CO5	Propose various regulations and safety norms.

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Text Books	
1.	R.C. Goyal, “Hospital Administration and Human Resource Management”, PHI – Fourth Edition, 2006.
2.	Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012).

Reference Books	
1.	G.D.Kunders, “Hospitals – Facilities Planning and Management – TMH”, New Delhi, Fifth Reprint 2007.
2.	Tweedy, James T., “Healthcare hazard control and safety management”, CRC Press, Taylor and Francis (2014).

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B.E. / B.Tech	B23BME920 – ERGONOMICS IN HEALTH CARE	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To enable the students to learn about the Fundamentals of Ergonomics in health care.
2.	To explore the occupational risks and apply preventive measures to reduce the risks.
3.	To have knowledge about the physiological workload in Health care environment situations.
4.	To learn about the workload and physical fitness and fatigue.
5.	To understand the methods and measurement of work behavior.

UNIT - I	DOMAINS OF ERGONOMICS	9
History, various domains of ergonomics, Physical Ergonomics – Anthropometry, Anatomy, Work Physiology, Biomechanics, Cognitive Ergonomics – Stress, Fatigue, perception, memory, reasoning, and motor response - Organizational Ergonomics - team work, job shifts, work satisfaction, schedules, policies, and ethics.		

UNIT - II	ERGONOMICS AND HEALTH	9
Occupational risks and apply preventive measures, Risk reduction, Man - Machine - Environment relationship and design, Relationship between Ergonomics and health, health, fitness and Postural risks, Impact of environment on Human Health, Preventive measures		

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UNIT - III	WORK PHYSIOLOGY & WORK STUDY	9
Differentiate people based on body types, need for food intake based on types of work, Body Type and somatotypes, Effect of posture on physiological functions, physical work environment, Types of fatigue, symptoms of fatigue, causes of fatigue.		

UNIT - IV	OCCUPATIONAL ERGONOMICS	9
Energy cost of various activities – physiological cost of work, Physical Fitness – Cardiorespiratory, Muscular Strength, Flexibility, etc. Body composition, Effect of Heat, Light, Noise, Vibration on Worker, Effect of fatigue on work.		

UNIT - V	METHOD AND MEASUREMENT OF WORK BEHAVIOUR	9
Introduction to Method and Measurement, – Method analysis, trends, physical consideration, work physiology-work-rest cycle and ergonomics-fitting job to man, Behavioral approaches, enlargement, principles of motion economy, motion study techniques, Work measurement – purpose, techniques of work measurements, time study, work sampling Work Posture-Methods of postural Assessment.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	To enable the students to learn about the Fundamentals of Ergonomics in health care.
CO2	To explore the occupational risks and apply preventive measures to reduce the risks.
CO3	To have knowledge about the physiological workload in laboratory and in field situations.
CO4	To learn about the Workload and physical fitness and fatigue.
CO5	To understand the work behaviour.

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Text Books	
1.	Anshel, J. (1998) : Visual Ergonomics in the Work Place, Taylor and Francis (UK, USA); published by Taylor and Francis, C., London.
2.	Pleasant, S. (1991) : Ergonomics, Work and Health, Mac Millan Press, London.
3.	Kroemer, K.H.E. and Grandjean, E. (1997) (5th edition) : Fitting the Task to the Human, Taylor and Francis (London, New York); published by Taylor and Francis,C., London.

Reference Books	
1.	Dul, J. and Weerdmeestre, B. (2001) : Ergonomics for Beginners : A Quick Reference Guide; 2nd edition, Taylor and Francis (London, New York); published by Taylor and Francis, C., London
2.	Oborne, D.J. (1987) : Ergonomics at Work, 2nd edition, John Wiley & Sons Ltd. Chichester, New York, Toronto
3.	Bare Act : The Professional Safety, Health and Working Conditions Code, 2020 (37 of 2020). Professional Book Publishers.
4.	Lee, G.C.H. (1999) : Advances in Occupational Ergonomics and Safety, IOS Press, Amsterdam, Berlin, Oxford, Tokyo, Washington) Amsterdam IOS Press C.

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B.E. / B.Tech	B23BME921 – HEALTH INFORMATICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To prepare the students in development, implementation, and use of modern health care information systems..
2.	To provide knowledge in interdisciplinary and integrated approach to health care IT.
3.	To study both the fundamental concepts and the cutting-edge IT technologies used in the design, implementation, and management of health care IT applications .
4.	To study the programming skills in Java.
5.	To study the programming skills in script languages.

UNIT - I	INTRODUCTION	9
Historical highlights and Evolution of Health informatics, Hospital Information System – its characteristics and functional online and offline modules, Health Informatics, Bioinformatics, Medical Informatics, Clinical Informatics, imaging Informatics, Nursing Informatics, Public Health Informatics, e – health services, Evidence Based Medicine, Bioethics, Virtual Hospital, Consumer Health Informatics and Healthcare Data Analytics.		

UNIT - II	ELECTRONICS PATIENT RECORDS AND STANDARDS	9
Electronic Patient Record, Medical data formats, – Medical Standards and Organizations – HL7 – DICOM - IRMA - LOINC - PACS - Medical Standards for Vocabulary - ICD 10, DRGs, MeSH, UMLS, SNOMED – JCAHO – HIPAA.		

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UNIT - III	BIOINFORMATICS AND TECHNOLOGIES	9
Bio-information technologies, Semantic web and Bioinformatics, Genome projects - Education and Training - Nano technology in Healthcare - Nanomedicine, Nanopharma, CNT based Nano sensor, BioCom chip, Medical Nanorobo - Virtual Reality and Multimedia Applications in Medicine.		

UNIT - IV	JAVA PROGRAMMING	9
Design and Development of Hospital Information Systems – Developing front-end, back-end and Client – Server interface programs in Java Environment – SQL.		

UNIT - V	INTERNET AND WEB	9
Medical Networks - Java script programming - Web Design and programming - Design of Web portal services in medicine .		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explore how technology can be used to improve health care delivery in health care organizations and in public health..
CO2	Acquire breadth of knowledge of the principles of health informatics.
CO3	Develop basic skills in using health informatics principles to improve practice.
CO4	Acquire a conceptual and theoretical framework of the design, development, and implementation of health information systems.
CO5	Develop programming skills in Java and script languages.

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Text Books	
1.	Robert E Hoyt, Ann Yoshihashi, Health Informatics: Practical Guide for Healthcare and Information Technology Professionals, 6th Edition, lulu.com, 2014.
2.	Yi-Ping Phoebe, Bioinformatics Technologies, Springer International, New Delhi, 2007.
3.	Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005
4	M Dietel, Internet and World Wide Web, AB Goldberg publishers, New Delhi, 2007

Reference Books	
1.	Mohan Bansal M S, Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005.
2.	Orpita Bosu, Bioinformatics – Databases, Tools and Algorithms, Oxford University Press, 2007.
3.	Ramachandra Lele, Computers in Medicine Progress in Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005

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VERTICAL 5

B.E. / B.Tech	B23BME922 – MEDICAL DEVICE DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Introduce the Medical device standards and requirements.
2.	Illustrate the design procedure of medical devices.
3.	Outline the quality assessment in design.
4.	Describe about the design realization.
5.	Understand the validation and verification of various medical devices.

UNIT - I	NEEDS FINDING AND CONCEPT GENERATION	9
Strategic Focus – observation and problem identification – Need statement development. Ideation and Brainstorming – concept screening, concept selection: intellectual property basics reimbursement basics – business models – prototyping – final concept selection. Safety and Risk Management - Tools, Documents and Deliverables.		

UNIT - II	MEDICAL DEVICES STANDARDS AND REQUIREMENTS	9
FDA, Medical devices classification, Medical Devices Directive Process – Harmonized Standards, ISO13485, ISO 14971, IEC60601-1, IEC 62304. NABL- Reliability, Concept of failure, Product Design and Development Process.		

UNIT - III	DESIGN ENGINEERING	9
Hardware Design, Hardware Risk Analysis, Design and Project Metrics, Design for Six Sigma, Software Design, Software Coding, Software Risk Analysis, Software Metrics.		
UNIT - IV	**TESTING AND VALIDATION**	**9**

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UNIT - V	DESIGN TRANSFER AND MANUFACTURING	9
Transfer to Manufacturing, Hardware Manufacturing, Software Manufacturing, Configuration Management, Intellectual Property - Copy Rights - Trademarks - Trade Secrets. Case Study.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Define the medical devices standards and requirements.
CO2	Summarise the concept of medical device development.
CO3	Recall the engineering design and project metrics.
CO4	Demonstrate the testing and validation of medical equipment.
CO5	Interpret the various design transfer and manufacturing methods.

Text Books	
1.	Zenios, Makower and Yock, “Biodesign – The process of innovating medical technologies”, Canbridge University Press, 2009.
2.	Theodore R. Kucklick, The Medical Device R & D Handbook, Second Edition, CRC Press, 2012.
3.	Peter Ogrodnik, Medical Device Design Innovation from Concept to Market, Elsevier, 2013.

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Reference Books	
1.	Richard C. Fries and Marcel Dekker AG, “Handbook of Medical Device Design”, 2nd edition, 2005.
2.	Gail Baura, “Medical Device Technologies : A Systems Based Overview Using Engineering”, Elsevier science, 2012.
3.	Matthew Bret Weinger, Michael E. Wiklund, Daryle Jean Gardner-Bonneau, “Handbook of Human Factors in Medical Device Design”, CRC press, 2010.
4.	Jagdish Chaturvedi, “Inventing medical devices : A perspective from India”, Create Space Independent Publishing Platform, 1st edition, 2015.

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B.E. / B.Tech	B23BME923 – EMERGENCY MEDICAL DEVICES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To learn about the fundamental concepts of Emergency medicine.
2.	To study about the casualty equipment and its role in emergency medicine.
3.	To emphasize the role of equipment's in emergency ward.
4.	To Gain knowledge on critical care.
5.	To know the fundamentals of maintenance and trouble shooting.

UNIT - I	INTRODUCTION TO EMERGENCY MEDICINE	9
Structure and organization of a hospital and its departments - Functioning of an ideal emergency medicine department - Emergency medicine: Casualty, Emergency Ward, Critical Care Area and operation theatre. Ambulance services - Pre-hospital care. The emergency response team - Documentation - Multiple and mass casualties - Medico-legal aspects.		

UNIT - II	CASUALTY EQUIPMENT AND INSTRUMENT	9
Emergency Patient shifting Trolley with Oxygen cylinder carrying facility, Wheelchair, Emergency Crash Cart trolley. Electrical Suction - Thermometer - Tracheostomy tray - Catheterisation tray - Suturing tray - Equipment for wound care - Pulse oximeter - NIBP - Sphygmomanometer - Weighing machine.		

UNIT - III	EMERGENCY WARD EQUIPMENT AND INSTRUMENT	9

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Emergency beds with propped up facility and railings - Central Oxygen and suction ports - Cardiac monitors.Resuscitation cart - Defibrillator - ECG machine - Infusion pumps, Equipment for intubation - Adult, Paediatric, Neonate. Portable suction machine, Ultrasonic Nebuliser, Glucometer. Infant radiant warmer with bassinet, Blood and fluid warmer, Electric warming blanket.

UNIT - IV	CRITICAL CARE AREA EQUIPMENT AND INSTRUMENT	9
Fowler beds - Central Oxygen and suction ports- Cardiac monitors - Resuscitation cart - Defibrillator ECG machine.		

UNIT - V	EQUIPMENT MAINTENANCE AND TROUBLE SHOOTING	9
Mechanical Ventilators & Non-invasive ventilators; Pumps : Infusion, syringe; Monitors : Stand-alone & multi-parameter, Cardiac Output monitors; ECG machine; ABG machine; Defibrillator; Ultrasound machine, Bronchoscope.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the fundamentals and purpose of emergency medicine.
CO2	Analyze functional aspects of casualty equipment's.
CO3	Identify the emergency ward equipment.
CO4	Summarize the fluid and hemodynamic derangements.
CO5	Outline about the equipment maintenance and calibration.

Text Books	
1.	The ICU Book – Paul L Marino (Lippincott, Williams & Wilkins)

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2.	Geddes and Bakar, “Principles of Applied Biomedical Instrumentation”, John Wiley and Sons Inc., New York, 1968.

Reference Books	
1.	“Medical Devices : A Practical Guide”, by Prakash Srinivasan and Timiri Shanmugam.
2.	R.S. Khandapur, “Hand Book of Biomedical Instrumentation”, Tata McGraw Hill Publishers, New Delhi,1990.

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B.E. / B.Tech	B23BME924 - MEDICAL EQUIPMENT TESTING AND CALIBRATION	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand and learn about testing of electrical equipment.
2.	To know testing of electronic components.
3.	To Gain knowledge about troubleshooting of instruments used for diagnosis and
4.	To learn the calibration of various medical equipment.
5.	To learn how to maintain the overall working of equipment.

UNIT - I	TESTING OF ELECTRICAL EQUIPMENTS	9
AC, DC power supply, Grounding, shielding, Guarding, insulation testing, insulation resistance measurement, Types of Circuit Breakers, Rating - Testing of circuit breakers – Tranformer testing - Earthing Earth wires - Earthing of appliances – contactor, relay testing – CT and PT, Panel wiring - Megger - Testing equipment and instruments.		

UNIT - II	TESTING AND TROUBLESHOOTING OF ELECTRONIC COMPONENTS	9
Testing of electronic components : Troubleshooting of PCB boards, Calibration of analog and digital sensor probe, Display interface, DC Power supply design, testing, Safe electrical practice, Cables and standard, Fuse.		

UNIT - III	TESTING OF MEDICAL EQUIPMENT	9
Testing of surgical Equipment: Functions and operating procedure-Testing and maintenance of Heart lung machine, surgical lights, ventilator, patient monitor, anesthesia machine, dialyzer, surgical tools.		

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UNIT - IV	CALIBRATION OF MEDICAL ELECTRONIC DEVICES	9
ECG; Infusion Pump, cardiac pacemaker, defibrillators, incubator, baby warmer, X-ray machines and annual maintenance, contract requirements, vendor services, and quality and safety standards.		

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UNIT - V	MAINTENANCE MANAGEMENT	9
Life cycle management of medical equipment: Cost of the medical equipment, maintenance cost, replacement analysis, managing equipment service, decision making.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Identify major reasons for equipment failure.
CO2	Compare general testing and troubleshooting of equipment.
CO3	Analyze the OT instruments.
CO4	Solve the calibration issues of medical equipment.
CO5	Analyze the management issues pertaining to medical instruments and safety standards.

Text Books	
1.	Carr – Brown, “Introduction to Biomedical Equipment Technology”, 2011, 1st Edition, Pearson, New York.
2.	Shakti Chatterjee, Aubert Miller, “Biomedical Equipment Repair”, Cengage Learning Technology & Engineering, 2010
3.	David Herres, “Troubleshooting and Repairing Commercial Electrical Equipment”, McGraw Hill, Professional edition, 2013.

Reference Books	
1.	John G. Webster, “Medical Instrumentation Application and Design”, 2015, 4th Edition, John Wiley and sons, New Jersey.

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2.	R S. Khandpur, “Handbook of Biomedical Instrumentation”, 2014, 3rd Edition, Tata Mc Graw Hill, New Delhi.
3.	Medical Devices : Regulations, Standards and Practices; 1st Edition, Imprint : Woodhead Publishing; Hardcover ISBN : 9780081002896 (Authors : Seeram Ramakrishna, Lingling Tian, Charlene Wang, Susan Liao, Wee Eong Teo)

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B.E. / B.Tech	B23BME925 – MEDICAL INNOVATION AND ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To learn fundamentals of entrepreneurship.
2.	To apply the methods of entrepreneurship in medical field.
3.	To develop effective business models.
4.	To evaluate the financial opportunities.
5.	To evaluate the medical devices and market trends.

UNIT - I	CREATIVITY, INNOVATION AND IPR	9

The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process. Patents – Copyright - Trademark - Geographical indications – Ethical and social responsibility and challenges.

UNIT - II	SCOPE FOR BIOMEDICAL ENGINEERING ENTREPRENEURSHIP	9

Definition – Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs. Fundamentals and models, Advancements in biomedical field, Supporting societies and professional activities. Impact of innovation in medical devices. Case study.

UNIT - III	NEW VENTURE	9

Developing an Effective Business Model : The Importance of a Business Model – Starting a small - scale industry - Components of an Effective Business Model. Assessing the venture, establish venture invention, market research, presenting the business plan. Forms of Business Organization : Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. case study., and start-ups.

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UNIT - IV	FINANCING THE NEW VENTURE AND GLOBALIZATION	9
Evaluating Various options and future investments – Medical Device entrepreneurship incentives and subsidies – Determining Financial Needs – Sources of Financing : support for product development, funding agencies, collaborative initiatives, and angel investors. Impact of Globalization : Medical product manufacturing, marketing, leadership, quality management. Case studies.		

UNIT - V	MARKETING FUNCTION	9
Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process. Case study.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Describe the role of biomedical engineers in entrepreneurship.
CO2	Interpret the background for biomedical engineers in entrepreneurship.
CO3	Acquire the skills and techniques required towards innovation.
CO4	Categorize the resources and funding agencies and judge the right product based on market.
CO5	Compile and quantify the opportunities and challenges.

Text Books	
1.	Jen-Shih Lee “Biomedical Engineering Entrepreneurship”, World Scientific Publishing, USA.
2.	Vasant Desai, “The Dynamics of Entrepreneurial Development and Management”, Himalaya Publishing House, 2010.

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Reference Books	
1.	Brant Cooper, Patrick Vlaskovits, “The Lean Entrepreneur”, Wiley, 2nd edition, New Jersy, 2016.
2.	Nathan Furr, Jeff Dyer, “The Innovator's Method : Bringing the Lean Start-up into Your Organization”, Harvard Business Press, Boston, 2014
3.	Donald F. Kuratko and Richard M. Hodgetts, “Entrepreneurship”, South-Western.
4.	Gupta S.L., Arun Mittal, “Entrepreneurship Development”, International Book House, 2012.

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B.E. / B.Tech	B23BME917- ARTIFICIAL ORGANS AND IMPLANTS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To have an overview of artificial organs and implants.
2.	To describe the principles of implant design with a case study.
3.	To explain the implant design parameters and solution in use.
4.	To study about various blood interfacing implants.
5.	To study about tissue replacement and hard tissue replacement.

UNIT - I	ARTIFICIAL ORGANS & TRANSPLANTS	9
Introduction, outlook for organ replacements, design consideration, evaluation process, overview of transplants, Immunological consideration, Blood transfusions, individual organs – kidney, liver, heart and lungs, bone marrow, cornea.		

UNIT - II	PRINCIPLES OF IMPLANT DESIGN	9
Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and it's replacement, Tissue engineering, scaffolds, cell and regulators criteria for materials selection, case study of organ regeneration.		

UNIT - III	IMPLANT DESIGN PARAMETERS AND IT'S SOLUTIONS	9
Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, natural and synthetic polymers, corrosion, wear and tear, Implants for Bone, Devices for nerve regeneration.		

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UNIT - IV	BLOOD INTERFACING IMPLANTS	9
Neular and neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney – dialysis membrane and artificial blood.		
UNIT - V	**IMPLANTABLE MEDICAL DEVICES AND ORGANS**	**9**
Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, soft tissue repair, replacement and augmentation, recent advancement and future directions.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Gain adequate knowledge about artificial organs & transplants.
CO2	Get clear idea about implant design and it's parameters and solution.
CO3	Have in-depth knowledge about blood interfacing implants.
CO4	Explain different types of soft tissues replacement and hard tissue replacement.
CO5	Assess compatibility and functioning of artificial organs inside the living system.
Text Books	
1.	Kopp W.J, Artificial organs, John Wiley and sons, New York , 1st edition, 1976

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Reference Books	
1.	J D Bronzino, Biomedical Engineering handbook Volume II, (CRC Press / IEEE Press), 2000.
2.	R S Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, 2003.
3.	Yannas, I.V, “Tissue and Organ Regenaration in Adults”, New York, NY : Springer, 2001. ISBN : 9780387952147.
4.	John Enderle, Joseph D. Bronzino, Susan M. Blanchard, “Introduction to Biomedical Engineering”, Elsevier, 2005.

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.E. / B.Tech	B23BME927 – IPR IN HEALTHCARE INDUSTRIES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To develop understanding of the basics of intellectual property law.
2.	To give overview of the domestic and international legal regime dealing with intellectual property law.
3.	To understand the current norms relating to bioethics and bio-safety in context of patenting.
4.	To understand Trademarks, Trade Secretes and GI of goods.
5.	To understand the concepts of Cyber laws in IPR.

UNIT - I	INTRODUCTION	9
Introduction to Intellectual Property Rights, types of intellectual property, importance of intellectual property rights in Healthcare industries, Evolution of IP acts and treaties, Agencies responsible for IPR registrations, Role and value of IP in international commerce, Issues affecting IP internationally.		

UNIT - II	TRADE MARKS	9
Purpose and function of trademarks, Acquisition of trade mark rights, transfer of rights, Selecting and evaluating trademark, registration of trademarks, claims. Trade Secrets: Trade secret law, determination of trade secret status, liability for misappropriation of trade secrets, Medical trade secret litigation. Geographical Indication of Goods: Basic aspects and need for the registration.		

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UNIT - III	PATENTS	9
Patents - Objective, Introduction, Requirement for patenting- Novelty, Inventive step (No obviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, compulsory license.		

UNIT - IV	ENFORCEMENT AND PRACTICAL ASPECTS OF IPR	9
Introduction – civil remedies – injunction, damage, account of profit – criminal remedies – patent, trademark. Practical aspects – Introduction, benefits of licensing, licensing of basic types of IPR, licensing clauses of IPR. Case studies of patent infringement, compulsory licensing, simple patent license agreements.		

UNIT - V	INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY	9
International Background of Intellectual Property- Paris Convention, Berne convention, World Trade Organization (WTO), World Intellectual Property Organization (WIPO), Trade Related Aspects of Intellectual Property Rights (TRIPS) and Patent Co-operation Treaty (PCT).		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Students will the concept of IPR and different subject matter of IPR like trademark, copyright, trade secret, Patent and geographical indication.
CO2	Students will develop and apply a personal understanding of patent and biosafety, and there impact on day to day life.
CO3	Understand the relation between IPR and bioethics and biosafety in relation to patent.
CO4	Provide the information about the different enforcements and practical aspects involved in protection of IPR.
CO5	Understand the interrelationships between different Intellectual Property Rights on International Society.

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Text Books	
1.	N. Nagpal, M. Arora, M.R.D. Usman, S. Rahar, “Intellectual Property Rights” Edu creation Publishing, New Delhi, 2017.
2.	B.S. Rao, P.V. Appaji, “Intellectual Property Rights in Medical Industry : Theory and Practice”, 2015.

Reference Books	
1.	Basic Principles of patent law – Basics principles and acquisition of IPR. Ramakrishna T. CIPRA, NLSIU, Bangalore, 2005.
2.	S. Lakshmana Prabu, TNK. Suriya prakash, “Intellectual Property Rights”, 1st ed., In Tech open access, Croatia, 2017.
3.	The Patents Act, 1970 (Bare Act with Short Notes) (New Delhi : Universal Law Publishing Company Pvt. Ltd. 2012.

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B.E. / B.Tech	B23BME928 – HAPTICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the theories, and concepts of human haptic system.
2.	To study the various haptic devices and its application.
3.	To explain the concepts of computational haptics.
4.	To learn the technology behind the virtual reality.
5.	To develop the haptic technology for various applications.

UNIT - I	HUMAN HAPTICS	9
Human senses - vision, audition and touch, Human haptic system, Multimedia haptics - audio visual ultimedia system.		

UNIT - II	HAPTICS DEVICES	9
Sensors and actuators, Computer aided design, touch haptic devices, PHANTOM device, Haptic feedback force feedback, vibrotactile feedback, Electro tactile feedback, ultrasonic tactile feedback, thermal feedback – its applications.		

UNIT - III	COMPUTATIONAL HAPTICS	9
Haptic Rendering; Rigid bodies, Deformable bodies, Stability Rendering effects, Human performance and evaluation; collision detection effects.		

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UNIT - IV	HAPTICS IN VIRTUAL REALITY	9
Virtual reality system, virtual environment representation and rendering, display technologies, input device to virtual reality system, interaction with virtual environment, virtual fixtures.		

UNIT - V	HAPTICS FOR MEDICAL APPLICATIONS	9
Surgical Simulations, Stroke-Based Rehabilitation, Support to the Visually Impaired, Tele-Robotics, Tele-Operation and Tele-Surgery.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the basic principles, theories, and concepts of haptics.
CO2	Comprehend human touch perception.
CO3	Build a haptic technology for medical applications.
CO4	Learn how to develop immersive user interfaces with haptic feedback.
CO5	Understand the causes of instability in virtual reality and teleoperation systems.

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Reference Books	
1.	A.El Saddik, Haptics Rendering and Applications, Intech, 2011.
2.	Femke Elise van Bee, Making Sense of Haptics : Fundamentals of Perception and Implications for Device Design, Springer International Publishing, 2017.

Text Books	
1.	Mark Paterson, The Senses of Touch : Haptics, Affects and Technologies, Bloomsbury, 2007.
2.	Abdulmotaleb El Saddik, Mauricio Orozco, Mohamad Eid, Jongeun Cha, Haptics Technologies - Bringing Touch to Multimedia - Springer - Verlag Berlin Hei , 2011

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Vertical 6

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App irman

B.E. / B.Tech	B23BME929 – ADVANCED BIO SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To describe fundamental concepts of DSP and Discrete Transforms.
2.	To design digital filters design.
3.	To estimate power spectrum using non- parametric and parametric methods.
4.	To analyze the Multirate Signal processing by decimation and interpolation.
5.	To apply the concept of multirate signal processing for various applications.

UNIT - I	DIGITAL SIGNAL PROCESSING	9

Sampling of analog signals - Selection of sampling frequency - Frequency response - Transfer functions - Filter structures - Fast Fourier Transform (FFT) Algorithms - Image coding - DCT.

UNIT - II	DIGITAL FILTER DESIGN	9

IIR and FIR Filters : Filter structures, Implementation of Digital Filters - 2^{nd} Order Narrow Band Filter and 1^{st} Order All Pass Filter, Frequency sampling structures of FIR, Lattice structures, Forward and Backward prediction error filters, Reflection coefficients for lattice realization, Implementation of lattice structures for IIR filters, Advantages of lattice structures.

UNIT - III	ESTIMATION OF POWER SPECTRUM	9

Non-Parametric Methods: Estimation of spectra from finite duration observation of signals: Bartlett, Welch & Blackman - Tukey methods, Performance Comparison. Parametric Methods : Autocorrelation & Its Properties, Relation between auto correlation & model parameters, AR Models - Yule - Walker & Burg Methods, MA & ARMA models for power spectrum estimation.

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UNIT - IV	MULTI RATE SIGNAL PROCESSING	9
Decimation by a factor D - Interpolation by a factor I - Sampling rate conversion by a rational factor I/D, Multistage Implementation of Sampling Rate Conversion, Filter design and Implementation for sampling rate conversion. Up-sampling using All Pass Filter.		

UNIT - V	APPLICATIONS OF MULTI RATE SIGNAL PROCESSING AND DSP INTEGRATED CIRCUITS	9
Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Narrow Band Low Pass Filters, Implementation of Digital Filter Banks, Subband Coding of Speech Signals, Quadrature Mirror Filters, Over Sampling A/D and D/A Conversion.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Describe the basics of Digital Signal Processing and Discrete Time Transforms.
CO2	Design and implement FIR / IIR digital filters using various structures.
CO3	Estimate power spectrum using appropriate parametric/non-parametric method.
CO4	Analyze discrete time system at different sampling frequencies using the concept of Multirate signal processing.
CO5	Design discrete time system for the given application using Multi rate signal processing.

Text Books	
1.	Fredric J Harris, “Multirate Signal Processing for Communication Systems”, Pearson Education, 2004.
2.	Behrouz Farhang - Boroujeny, “Signal Processing Techniques for Software Radios”, Lulu Publishing House, 2008.
3.	Jeffrey H Reed, “Software Radio : A Modern Approach to Radio Engineering”, Prentice Hall PTR, 2002

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Reference Books	
1.	P.P. Vaidyanathan, Multirate Systems and Filter Banks, Pearson Education, 2006
2.	N.J. Fliege, Multirate Digital Signal Processing, John Wiley, 1994, K.K. Parhi, VLSI Digital Signal Processing Systems: Design and Implementation, Wiley, 1999.
3.	Sanjit K. Mitra, Digital Signal Processing : A Computer based Approach, Special Indian Edition, McGraw Hill, 2013.
4.	Fredric J Harris, Multirate Signal Processing for Communication Systems, 1st Edn., Pearson Education, 2007.
5.	Multi Rate Systems and Filter Banks - P.P. Vaidyanathan - Pearson Education.

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B.E. / B.Tech	B23BME930 – MEDICAL IMAGE ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To learn the fundamental concepts of medical Image Processing techniques.
2.	To understand the concepts of various image intensity transformation and filtering operations.
3.	To be familiar in the techniques of segmentation and restoration of medical images.
4.	To gain knowledge in medical image registration and visualization.
5.	To be familiar with the application of medical image analysis.

UNIT - I	FUNDAMENTALS OF MEDICAL IMAGE PROCESSING AND TRANSFORMS	9

Overview of Image Processing system and human Visual system - Image representation – pixel and voxels, Grayscale and color models - Medical image file formats - DICOM, ANALYZE 7.5, NIFTI and INTERFILE - Discrete sampling model and Quantization - Relationship between the pixels, Arithmetic and logical operations - Image quality and Signal to Noise ratio - Image Transforms - 2D DFT, DCT, KLT. Interpret the basics of image models, Digitization of images and the transformations of medical images using Matlab.

UNIT - II	ENHANCEMENT TECHNIQUES	9

Gray level transformation - Log transformation, Power law transformation, Piecewise linear transformation. Histogram processing - Histogram equalization, Histogram Matching. Spatial domain Filtering - Smoothing filters, sharpening filters. Frequency domain filtering - Smoothing filters, Sharpening filters - Homomorphic filtering - Medical image enhancement using Hybrid filters Performance measures for enhancement techniques. Experiment with various filtering techniques for noise reduction and enhancement in medical images using Matlab.

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UNIT - III	SEGMENTATION AND RESTORATION TECHNIQUES	9
ROI definition - Detection of discontinuities – Edge linking and boundary detection – Region based segmentation - Morphological processing, Active contour models. Image Restoration - Noise models – Restoration in the presence of Noise – spatial filtering, Periodic noise reduction by frequency domain filtering- linear position - Invariant degradation - Estimation of degradation function, Inverse filter, Weiner filtering. Analyze the segmentation techniques to extract the region of interest and restoration of degraded images using Matlab.		

UNIT - IV	REGISTRATION AND VISUALISATION	9
Registration - Rigid body transformation, principal axes registration, and feature based. Visualisation - Orthogonal and perspective projection in medicine, Surface based rendering, Volume visualization in medical image. Explain the significance of registration of various imaging modalities and appraise the concepts of image visualization in healthcare using Matlab.		

UNIT - V	APPLICATIONS OF MEDICAL IMAGE ANALYSIS	9
Medical Image compression - DCT and Wavelet transform based image compression, Preprocessing of medical images - Retinal images, Ultrasound – liver, kidney, Mammogram. Segmentation of ROI - blood vessels, lesions, tumour, lung nodules, feature extraction - shape and texture, Computer aided diagnosis system – performance measures (confusion matrix, ROC, AUC).		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain and apply the fundamental concepts of image processing techniques for the analysis of medical images.
CO2	Identify and apply suitable filtering and intensity transformation techniques for given medical applications.
CO3	Identify and segment the Region of Interest from the given medical image.

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CO4	Explore and apply current research in registration and visualization for medical image analysis.
CO5	Design and evaluate the use of image processing fundamentals in healthcare applications,

Text Books	
1.	Atam P. Dhawan, Medical Image Analysis, Wiley-Interscience Publication, NJ, USA, 2003.
2.	Rangaraj M., "Rangayyan, Biomedical Image Analysis", 1st Edition, CRC Press, Published December 30, 2004.
3.	Joseph V.Hajnal, Derek L.G.Hill, David J Hawkes, "Medical image registration", Biomedical Engineering series, CRC Press, 2001
4.	Milan Sonka, Image Processing, Analysis and Machine Vision, Brookes / Cole, Vikas Publishing House, 2nd edition, 1999.

Reference Books	
1.	Isaac N. Bankman, "Handbook of Medical Image Processing and Analysis" (Academic Press Series in Biomedical Engineering). 2nd edition - 19 December 2008.
2.	Anil Jain K, Fundamentals of Digital Image Processing, PHI Learning Pvt. Ltd., 2011

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B.E. / B.Tech	B23BME931 – SPEECH AND AUDIO SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To Understand the key areas of articulatory and acoustic phonetics, focusing on the production of voiced and unvoiced sounds.
2.	To understand how the auditory system processes sound and contributes to speech perception.
3.	To learn time-domain and frequency-domain methods used for audio processing.
4.	To be equipped with a strong grasp of LPC techniques and their real-world applications in processing speech signals.
5.	To learn various applications of speech and audio processing technologies.

UNIT - I	FUNDAMENTALS OF SPEECH PRODUCTION	9
Nature of the speech signal, linear time-varying model, articulatory phonetics, acoustic phonetics, Voiced and Unvoiced speech. Anatomy and physiology of speech production, Human speech production mechanism, LTI model for speech production.		

UNIT - II	HUMAN AUDITORY SYSTEM	9
Human auditory system, simplified model of cochlea, sound pressure level and loudness. Sound intensity and Decibel sound levels. Concept of critical band and auditory system as a filter bank, Uniform, non uniform filter bank, mel scale and bark scale, speech perception : vowel perception.		

UNIT - III	TIME AND FREQUENCY DOMAIN METHODS FOR AUDIO PROCESSING	9
Time-dependent speech processing and parameters, silence discrimination, short-time autocorrelation function, short-time average magnitude difference function. Pitch period estimation using autocorrelation method. Audio feature extraction, Spectral parameters, spectrogram: narrow band and wide band spectrogram.		

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UNIT - IV	LINEAR PREDICTION ANALYSIS	9
Basic principles of linear predictive analysis: autocorrelation method and covariance method. Solution of LPC equations : Cholesky decomposition, Durbin's recursive solution, lattice formulations and solutions. Frequency domain interpretation of LP analysis. Applications of LPC parameters as pitch detection and formant analysis.		

UNIT - V	SPEECH AND AUDIO PROCESSING APPLICATIONS	9
Speech recognition : isolated word recognition with vector quantization, dynamic time warping, speaker recognition : speaker identification, verification. Speech enhancement using spectral subtraction method, Text to speech conversion, Musical instrument classification, Musical Information retrieval.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Demonstrate the ability to classify speech signals as voiced or unvoiced based on acoustic features.
CO2	Select the simplified cochlea model and its role in the auditory system's sound processing.
CO3	Apply time-domain methods such as silence discrimination to segment speech and non-speech parts in audio signals.
CO4	Make use of LPC parameters for applications such as pitch detection and formant analysis in speech processing systems.
CO5	Examine the performance of speaker recognition systems and identify their limitations in real-world scenarios.

Text Books	
1.	Deller J.R. Proakis J.G. and Hanson J.H., "Discrete Time Processing of Speech Signals", Wiley Interscience.
2.	Ben Gold and Nelson Morgan, "Speech and audio signal processing" Wiley.

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Reference Books	
1.	L.R. Rabiner and S.W. Schafer, “Digital processing of speech signals” Pearson Education.
2.	Thomas F. Quateri , “Discrete-Time Speech Signal Processing : Principles and Practice” Pearson
3.	Dr. Shaila Apte, “Speech and audio processing”, Wiley India Publication
4.	L.R. Rabiner and B.H. Juang, “Fundamentals of speech recognition”
5.	Theodoros Giannakopoulos and Aggelos pikrakis, “Introduction to audio analysis : A MATLAB” Approach : Eleseiver Publication.

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B.E. / B.Tech	B23BME932 – RADIO IMAGING TECHNIQUES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To Learn the fundamental concepts of medical Image Processing techniques.
2.	To Understand the concepts of various image intensity transformation and filtering operations.
3.	To Be familiar in the techniques of segmentation and restoration of medical images.
4.	To Gain knowledge in medical image registration and visualization.
5.	To Be familiar with the application of medical image analysis.

UNIT - I	FUNDAMENTALS OF MEDICAL IMAGE PROCESSING AND TRANSFORMS	9

Overview of Image Processing system and human Visual system - Image representation – pixel and voxels, Grayscale and color models - Medical image file formats - DICOM, ANALYZE 7.5, NIFTI and INTERFILE - Discrete sampling model and Quantization - Relationship between the pixels, Arithmetic and logical operations - Image quality and Signal to Noise ratio - Image Transforms - 2D DFT, DCT, KLT. Interpret the basics of image models, Digitization of images and the transformations of medical images using Matlab.

UNIT - II	ENHANCEMENT TECHNIQUES	9

Gray level transformation - Log transformation, Power law transformation, Piecewise linear transformation. Histogram processing - Histogram equalization, Histogram Matching. Spatial domain Filtering - Smoothing filters, sharpening filters. Frequency domain filtering - Smoothing filters, Sharpening filters - Homomorphic filtering - Medical image enhancement using Hybrid filters Performance measures for enhancement techniques. Experiment with various filtering techniques for noise reduction and enhancement in medical images using Matlab.

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UNIT - III	SEGMENTATION AND RESTORATION TECHNIQUES	9
ROI definition - Detection of discontinuities – Edge linking and boundary detection – Region based segmentation - Morphological processing, Active contour models. Image Restoration - Noise models – Restoration in the presence of Noise – spatial filtering, Periodic noise reduction by frequency domain filtering - linear position - Invariant degradation - Estimation of degradation function, Inverse filter, Weiner filtering. Analyze the segmentation techniques to extract the region of interest and restoration of degraded images using Matlab.		

UNIT - IV	REGISTRATION AND VISUALISATION	9
Registration – Rigid body transformation, principal axes registration, and feature based. Visualisation - Orthogonal and perspective projection in medicine, Surface based rendering, Volume visualization in medical image. Explain the significance of registration of various imaging modalities and appraise the concepts of image visualization in healthcare using Matlab.		
UNIT - V	**APPLICATIONS OF MEDICAL IMAGE ANALYSIS**	**9**
Medical Image compression - DCT and Wavelet transform - based image compression, Preprocessing of medical images - Retinal images, Ultrasound – liver, kidney, Mammogram. Segmentation of ROI - blood vessels, lesions, tumour, lung nodules, feature extraction - shape and texture, Computer-aided diagnosis system – performance measures (confusion matrix, ROC, AUC).		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Apply the fundamental concepts of image processing techniques for the analysis of medical images.
CO2	Identify and apply suitable filtering and intensity transformation techniques for given medical applications.
CO3	Identify and segment the Region of Interest from the given medical image.
CO4	Select current research in registration and visualization for medical image analysis.
CO5	Apply the image compression techniques.

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Text Books	
1.	Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Pearson Education, 3rd edition, 2016.
2.	Isaac N. Bankman, Handbook of Medical Image Processing and Analysis, 2nd Edition, Elsevier, 2009.
3.	Wolfgang Birkfellner, Applied medical Image Processing : A Basic course, CRC Press, 2011

Reference Books	
1.	Atam P.Dhawan, Medical Image Analysis, Wiley-Interscience Publication, NJ, USA, 2003.
2.	Rangaraj M. "Rangayyan, Biomedical Image Analysis", 1st Edition, CRC Press, Published December 30, 2004.
3.	Joseph V. Hajnal, Derek L.G.Hill, David J Hawkes, "Medical image registration", Biomedical Engineering series, CRC Press, 2001
4.	Milan Sonka, Image Processing, Analysis And Machine Vision, Brookes / Cole, Vikas Publishing House, 2nd edition, 1999.
5.	Anil Jain K, Fundamentals of Digital Image Processing, PHI Learning Pvt. Ltd., 2011.

Program Coordinator

Approved by BOS Chairman

B.E. / B.Tech	B23BME933 – VIDEO PROCESSING AND ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the video representation and motion analysis tools.
2.	To learn the techniques used for video segmentation.
3.	To discuss the various object tracking techniques.
4.	To understand the various video data collection and management techniques.
5.	To elaborate on video analytics techniques.

UNIT - I	VIDEO PROCESSING	9
Digital video, 2D and 3-D Feature Detection and Matching – points and patches, tomography, Motion estimation : Motion Models, Optical flow, Matching methods.		

UNIT - II	VIDEO SEGMENTATION AND EXTRACTION	9
Video Basics, Video Segmentation and Keyframe Extraction. Motion estimation and Compensation - Motion Segmentation – Optical Flow Segmentation - Segmentation for Layered Video Representation. Background Modeling - Shadow Detection – Object Detection - Local Features - Mean Shift : Clustering.		

UNIT - III	VIDEO OBJECT TRACKING	9
Video object tracking : Template matching, Mean-shift tracking, Kalman and Particle Filters, Tracking by detection. Anamoly detection.		

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UNIT - IV	VIDEO DATA COLLECTION AND MANAGEMENT	9
Data Collection and Management : Case Selection and Validity in Video Data Analysis, Collecting Custom-Made Data, Collecting Ready-Made Data, Triangulation, Data Management, Analyzing Video Data : Coding and concepts, Timing and sequence, Counts and quantifications, Rhythm and turn-taking, Studying Actors.		

UNIT - V	VIDEO ANALYTICS	9
Video Processing – use cases of video analytics - Vanishing Gradient and exploding gradient problem - RestNet architecture - RestNet and skip connections - Inception Network - GoogleNet architecture Improvement in Inception v2-Video analytics - RestNet and Inception v3,Case Studies on Patient Care and Interaction Analysis and Healthcare Facility Environment and Operations		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Identify the video representation and motion analysis tools.
CO2	Develop various techniques used for video segmentation.
CO3	Choose various object tracking techniques.
CO4	Select various video data collection and management techniques.
CO5	Elaborate on deep learning-based video analytics.

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Text Books	
1.	Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer; 2021.
2.	Anne Nassauer, Nicolas M. Legewie, “Video Data Analysis”, SAGE Publishers, 2022.

Reference Books	
1.	A. MuratTekalp, “Digital Video Processing”, Pearson, 1995.
2.	Richard Szeliski, “Computer Vision : Algorithms and Applications”, Springer Verlag London Limited, 2011.
3.	Thierry Bouwmans, FatihPorikli, Benjamin Höferlin and Antoine Vacavant, “Background Modeling and Foreground Detection for Video Surveillance : Traditional and Recent Approaches, Implementations, Benchmarking and Evaluation”, CRC Press, Taylor and Francis Group; 2014

Program Coordinator

Approved by BOS Chairman

B.E. / B.Tech	B23BME934 – SOFT COMPUTING IN HEALTHCARE	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To learn fuzzy logic theory.
2.	To understand optimization methods.
3.	To gain fundamental knowledge of rough sets.
4.	To study hybrid soft computing with case studies.
5.	To learn different soft computing frameworks for healthcare applications.

UNIT - I	FUZZY SET THEORY	9

Introduction to Neuro - Fuzzy and Soft Computing - Fuzzy Sets - Basic Definition and Terminology - Set - theoretic Operations - Member Function Formulation and Parameterization - Fuzzy Rules and Fuzzy Reasoning - Extension Principle and Fuzzy Relations - Fuzzy If - Then Rules - Fuzzy Reasoning - Fuzzy Inference Systems - Mamdani Fuzzy Models - Sugeno Fuzzy Models - Tsukamoto Fuzzy Models.

UNIT - II	OPTIMIZATION	9

Derivative-based Optimization - Descent Methods - The Method of Steepest Descent – Classical Newton's Method - Step Size Determination - Derivative free Optimization - Genetic Algorithm - Simulated Annealing - Random Search - Downhill Simplex Search.

UNIT - III	ROUGH SETS	9

Rough sets - Rough set theory - Set approximation - Rough membership - Attributes Dependency of attributes - Rough equivalence - Reducts - Rough reducts based on SVM - Hybrid set systems - Fuzzy rough sets.

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UNIT - IV	HYBRID TECHNIQUES	9
ANN concepts - Adaptive Neuro - Fuzzy Inference Systems - Architecture - Hybrid Learning Algorithm - Coactive Neuro Fuzzy Modeling - Neuro-Fuzzy Spectrum - Neuro - Fuzzy - GA systems and case studies.		

UNIT - V	APPLICATIONS OF COMPUTATIONAL INTELLIGENCE	9
Neural networks for facial and emotion recognition - Detection of brain disorders - Study of cardiac conditions - Soft Computing for detection of Chest disorders.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the fuzzy logic theory.
CO2	Illustrate various derivative optimization methods.
CO3	Explain the concepts related to rough sets.
CO4	Apply hybrid soft computing techniques with case studies.
CO5	Outline different soft computing frameworks for healthcare applications.

Text Books	
1.	S.R. Jang, C.T. Sun and E. Mizutani, “Neuro Fuzzy and Soft Computing”, Pearson Education, 2015.
2.	N.P.Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press, 2005.

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Reference Books	
1.	Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw-Hill, 3ed., 2011. 134
2.	Davis E.Goldberg, “Genetic Algorithms : Search, Optimization and Machine Learning, Addison Wesley, N.Y., 1989.
3.	S. Rajasekaran and G.A.V. Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2013.
4.	R. Eberhart, P. Simpson and R. Dobbins, “Computational Intelligence - PC Tools”, Academic Press Professional, Boston, 1996.
5.	Dr. S.N. Sivanandam and S.N. Deepa, “Principles of Soft Computing”, Wiley India, 3rd Edition, 2018.
6.	Vladik Kreinovich and Nguyen Hoang Phuong , “Soft Computing for Biomedical Applications and Related Topics”, Springer, 2021.

Program Coordinator

Approved by BOS Chairman

B.E. / B.Tech	BM23BM935 - FINITE ELEMENT MODELLING IN HEALTHCARE	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the concept of Finite Element Method.
2.	To recognize the global matrix to understand the material properties.
3.	To know the mathematical model for biomedical engineering problems.
4.	To learn the different material properties.
5.	To study the implants for biological system.

UNIT - I	GENERAL INTRODUCTION	9

Historical Background of Engineering Modeling - Governing Equations for Field Problems Discrete and Continuous Models - Boundary, Initial, and Eigenvalue Problems - Variational Formulation of Boundary Value Problems - Ritz Technique for Approximation - Natural and Essential Boundary Conditions.

UNIT - II	INTRODUCTION TO FINITE ELEMENT METHOD	9

Basic Concepts of Finite Element Method-Solving One-Dimensional Second Order Equations - Discretization and Different Element Types - Linear and Higher Order Elements Deriving Shape Functions, Stiffness Matrices, and Force Vectors - Assembly of Matrices Application in Solid Mechanics and Biomechanics - Analysis of Structures, Stress, and Strain

UNIT - III	BEAM ELEMENTS AND SCALAR PROBLEMS IN 2D	9

Beam Equations and Transverse Deflections-Determining Natural Frequencies and Longitudinal Vibration of Beams - Second Order 2D Equations with Scalar Variables Formulating Variational and Finite Element Methods - Triangular Elements and Shape Functions - Applications in Biomechanics.

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UNIT - IV	ISOPARAMETRIC ANALYSIS	9
Introduction to Elasticity Equations and Stress - Strain Relations - Plane Problems of Elasticity and Element Equations - Plane Stress, Plane Strain, and Axisymmetric Problems Modeling Soft Connective Tissue Components - Analyzing Musculoskeletal Systems Stress Calculations and Introduction to Plate and Shell Elements - Basics of Fluid Mechanics and Flow Problems.		
UNIT - V	**NONLINEAR ANALYSIS**	**9**
Introduction to Non-Linear Problems and Solution Methods - Computational Procedure for Non- Linear Analysis - Considerations for Material Nonlinearity and Contact Interfaces Exploring Geometric Nonlinearity - Impact Analysis and Modeling Considerations Mechanical Properties of Materials - Finite Element Analysis in Biomechanical Research : Applications and Limitations		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the concept of Finite Element Method and realize its limitations.
CO2	Interpret the global matrix to understand the material properties.
CO3	Identify mathematical model for biomedical engineering problems.
CO4	Solve the model with different material property.
CO5	Make use of the finite element software to design implants for biological system.

Text Books	
1.	Zhangxin Chen. “Finite element methods and their applications”, Springer, 2005.

Reference Books	
1.	Seshu. P. Text book of “Finite Element Analysis”, Prentice Hall of India, 2003
2.	J.N. Reddy, “Finite Element Method”, Tata McGraw Hill, 2003.
3.	S.S. Rao, “The Finite Element Method in Engineering”, Butter worth heinemann, 2001.
4.	Reddy, J.N, “An Introduction to the Finite element Method”, McGraw-Hill, 1985.

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OPEN ELECTIVE

Open Elective - I

B.E.	B23AEO501- PRINCIPLES OF FLIGHT (Common to all Except AERO)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study the different component systems and functions.
2.	To understand the basic properties and principles behind the flight.
3.	To study the basic concepts of Aerodynamics.
4.	To study the different structures & construction.
5.	To study the various types of power plants used in aircrafts.

UNIT - I	AIRCRAFT CONFIGURATIONS	9
Brief History-Components of an airplane and their functions. Different types of flight vehicles, classifications. Basic instruments for flying.		

UNIT - II	INTRODUCTION TO PRINCIPLES OF FLIGHT	9
Physical properties and structure of the atmosphere, Temperature, pressure and altitude relationships, Evolution of lift, drag and moment. Different types of drag.		

UNIT - III	INTRODUCTION TO AERODYNAMICS	9
Aerodynamic forces on aircraft – classification of NACA aerofoils, aspect ratio, wing loading, Mach number, centre of pressure and aerodynamic centre-aerofoil characteristics lift, drag curves.		

UNIT - IV	INTRODUCTION TO AIRPLANE STRUCTURES AND MATERIALS	9
General types of construction, Monocoque, semi-monocoque. Typical wing and fuselage structure. Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials.		

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UNIT - V	POWER PLANTS USED IN AIRPLANES	9
Basic ideas about piston, turboprop and jet engines, Use of propeller and jets for thrust production., Principles of operation of rocket, types of rockets		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Identify the types and classification of components and control system.
CO2	Identify the properties and principles to analyze lift, drag (including types), moment, and their variation with altitude.
CO3	Identify the aerodynamics forces and NACA Airfoils.
CO4	Identify different type of fuselage and constructions.
CO5	Categorize the different types of engines and principles of rocket.

Text Books	
1.	Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition, 2015
2.	E Rathakrishnan, “Introduction to Aerospace Engineering: Basic Principles of Flight”, John Wiley, NJ, 2021

Reference Books	
1.	Kermode, A.C., “Flight without Formulae”, McGraw-Hill, 1997.
2.	Sadhu Singh, “Internal Combustion Engines and Gas Turbine”, SS Kataraia & Sons, 2015.
3.	Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.

Programme Coordinator

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B.Tech.	B23AGO501 - Farm Automation	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the fundamentals and scope of farm automation systems.
2.	To study various types of sensors and their role in smart farming.
3.	To analyze the working of automation systems in field operations.
4.	To explore greenhouse automation and resource management.
5.	To examine the role of advanced technologies like AI, drones, and robotics in agriculture.

UNIT I	INTRODUCTION TO FARM AUTOMATION	9
Definition and scope – Historical development – Classification of automation systems: manual, semi-automated and fully automated – Benefits of automation – Limitations and challenges – Status of automation in Indian agriculture – Automation in small and large farms – Farm automation value chain – Socio-economic implications.		

UNIT II	SENSORS AND SMART FARMING COMPONENTS	9
Types of sensors: soil moisture, pH, temperature, humidity, light, nutrient sensors – Actuators – Microcontrollers and microprocessors (Arduino, Raspberry Pi) – IoT architecture for agriculture – Wireless sensor networks – Communication protocols – Data acquisition and cloud connectivity – Mobile apps and remote monitoring systems.		

UNIT III	AUTOMATION IN FIELD OPERATIONS	9
Automatic steering and GPS-guided tractors – Variable Rate Technology (VRT) – Autonomous planters and seeders – Spraying automation – Robotic weeders – Harvesting automation – Drones for crop health monitoring – Field mapping – Automation kits – Safety aspects in field automation.		

UNIT IV	GREENHOUSE AND RESOURCE MANAGEMENT AUTOMATION	9
Greenhouse control systems: Temperature, humidity, light, CO_2 , irrigation and nutrient management – Automation of fertigation and irrigation (drip, sprinkler) – Scheduling using weather data – Software tools and apps for DSS – Renewable energy-based automation – Case studies of protected cultivation systems.		

UNIT V	ADVANCED TECHNOLOGIES IN AUTOMATION	9
Artificial Intelligence (AI) and Machine Learning (ML) in farming decisions – Robotics in seeding, pruning, sorting and packaging – Machine vision systems – Drones and UAVs in agriculture – Automation for post-harvest management – Success stories from India and abroad – Future prospects and trends.		
		Total Instructional Hours: 45

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COURSE OUTCOMES: Students will be able to	
CO1	Explain the concept and scope of farm automation.
CO2	Identify and interpret various sensors and smart devices in agriculture.
CO3	Apply automation techniques in field operations.
CO4	Demonstrate the application of automation in greenhouse and resource management.
CO5	Evaluate advanced automation technologies and their integration into smart farming systems.

Text Books	
1.	Nageshwar Rao, *Precision Farming and Agricultural Automation*, Kalyani Publishers, 2020.
2.	Manjunatha K.S., *Farm Machinery and Automation*, Jain Brothers, New Delhi, 2018.
3.	Rajvir Yadav, *Agricultural Automation*, Biotech Books, New Delhi, 2021.

References	
1.	CIGR Handbook of Agricultural Engineering Volume VI – Information Technology, ASABE, USA.
2.	Mehta M.L., Verma S.R., and Sharma V.K., *Farm Machinery and Power Engineering*, Jain Brothers.
3.	Internet of Things: https://nptel.ac.in/courses/106105166
4.	Articles and Case Studies from ICAR, IARI, and SmartFarm India

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B.E/ B.TECH	B23ADO501– GEN AI WITH OPEN SOURCE FRAMEWORK	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To Understand the Core Concepts of Artificial Intelligence
2.	To explain the Fundamentals of Generative AI and Its Architectures
3.	To Outline Open-Source GenAI Tools and Frameworks
4.	To identify the Prompt Engineering Techniques and Build Chatbots
5.	To study the Real-World Applications of Generative AI in Open-Source Domains

UNIT-I	BASICS OF AI	9

Introduction to AI - Future of AI – Applications of AI – History of AI- Types of AI- Intelligent Agent: Types of Agents- Characteristics of Intelligent Agents - Structure of Agents – Agents and Environments- Examples of AI.

UNIT-II	GEN AI MODELS	9

Introduction of Gen Ai- Sub Sets of Gen Ai- Model Creation - Types of Generative Ai transformer Based Architecture -LLM- GAN architecture - Training GANs and challenges) - Variants of GANs- VAE : Encoder, Decoder, and Latent space- Applications of VAEs

UNIT-III	OPEN SOURCE GEN AI	9

Gen AI in open source - Benefits of Open source AI -Open source tools for generative AI - Deep learning frameworks for generative AI- Advantages and Disadvantages of these frameworks

UNIT-IV	PROMPT ENGINEERING & CHATBOT DEVELOPMENT	9

Basics of Prompt Engineering- Few-shot - Zero-shot prompting - Prompt tuning vs Fine-tuning - Building a chatbot using: Lang Chain -RAG (Retrieval-Augmented Generation)

UNIT-V	USE CASES OF GEN AI IN OPEN SOURCE	9

Open-Source Generative AI Models-generative ai use cases in open source- visual content- audio generation- Text generation- Manufacturing- Supply chain and logistics- Retail & e-commerce- Automotive.

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	Total Instructional hours: 45

Course Outcomes: Students will be able to	
CO1	Explain Intelligent agents, and their interaction with environments.
CO2	Identify the structure and working principles of various Generative AI models
CO3	Apply open-source tools, frameworks, and platforms
CO4	Discover prompt engineering techniques
CO5	Examine use cases of Generative AI across various domains
TextBooks	
1.	Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson, 2021.
2.	Goodfellow I, Bengio Y and Courville, "A Deep Learning", MIT Press. Foster, D, 2022
Reference Books	
1.	Chollet, F. "Deep Learning with Python", Manning Publications, 2018
2.	Martin Musiol, "Generative Ai: Navigating the Course to the Artificial General Intelligence Future", John Wiley Sons, 2024

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B.E / B.Tech	B23AMO501 – PRINCIPLES OF MACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the concepts of Machine Learning.
2.	To study the Supervised Learning with Classifications.
3.	To analyse Random Forest methods and Backpropagation.
4.	To identify the Clustering Techniques for Data Analysis.
5.	To infer the applications of Machine Learning and Dimensionality Analysis.

UNIT - I	INTRODUCTION	9

Introduction to Machine Learning – Need of Machine Learning – Machine Learning Applications – Types of Machine Learning Systems – Challenges – Machine Learning Process – Data Collection – Exploration – Preparation – Training – Optimization – Performance Measures.

UNIT - II	SUPERVISED LEARNING	9

Classification and Regression Technique – Linear Regression – Polynomial Regression – Logistic Regression – Generalization – Overfitting – Underfitting – Support Vector Machine – Kernels – KNN – Naïve Bayes Classifiers – Decision Tree.

UNIT - III	ENSEMBLE LEARNING TECHNIQUES	9

Random Forest – Ensemble Learning – Bagging – Boosting – Ada Boost – Gradient Boosting – Neural Networks – ANN Perceptron – MLP's and Backpropagation – Hyperparameter Optimization – Dimensionality Reduction.

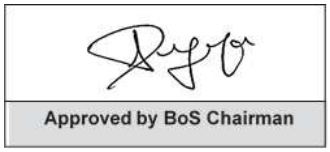
UNIT - IV	UNSUPERVISED LEARNING	9

Clustering – Techniques – K-Means Clustering – AGNES – DIANA – Density Based Clustering (DBSCAN) – Grid Based Clustering – Gaussian Mixtures – Clustering High Dimensionality Data – Outlier Analysis.

UNIT - V	APPLICATIONS OF ENSEMBLE LEARNING	9

Dimensionality Reduction Applications – Factor Analysis – Model Selection & Evaluation – Visualization of Results – Applications of ML : Medical Science, Fraud Detection, Traffic Prediction, Personal Assist, Stock Prediction.

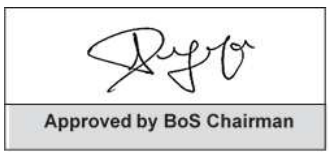
Total Instructional hours: 45



Text Books	
1.	Muller, Andreas C., and Sarah Guido. "Introduction to Machine Learning with Python : A Guide for Data Scientists." 3rd Edition, "O'Reilly Media, Inc.", 2016.
2.	Geron, Aurelien. Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow : Concepts, Tools, and Techniques to build intelligent systems. 1st Edition, "O'Reilly Media, Inc.",

Reference Books	
1.	Himanshu Singh, Yunis Ahmed Lone, Deep Neuro-Fuzzy Systems with Python : With Case Studies and Applications from the Industry, 3rd Edition, 2019.
2	Leonardo De Marchi, Hands-On Neural Networks : Learn how to Build and Train Your First Neural Network Model using Python Book, 1st Edition, 2019.
3	James Loy, Neural Network Projects with Python : The Ultimate Guide to using Python to explore the true power of neural networks through six projects. 1st Edition, Kindle Edition,

Course Outcomes : Students will be able to	
CO1	Recall the basics of Machine Learning
CO2	Illustrate the Classification and Regressions
CO3	Identify the Concepts of Neural Networks and Ensemble Learning
CO4	Analyze the features of unsupervised Learning
CO5	Explain the applications of Machine Learning



B.E / B.Tech	BM23BMO501- PRINCIPLES OF BIOSENSORS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study the basic structural ,functional elements, the gaseous exchange and fluid maintenance of the human body.
2.	To learn the organs and structures involved in system formation and functions.
3.	To understand the functions of physiological system
4.	To Know the activity of sensory and motor nerves
5.	To analyse Different Physiological Conditions in the Human Body.

UNIT - I	INTRODUCTION TO BIOSENSOR	9
Biosensors- Advantages and limitations, various components of biosensors, Classification of Biosensors Based on Type of Transduction - Electrochemical, Optical, Acoustic, Calorimetric. Classification of Biosensors Based on Biological Element - Enzyme Sensor, Immunosensors, Cell-based Sensors		

UNIT - II	DESIGN OF BIOSENSOR	9
Introduction, Assay format, Immobilisation-Ligand Activity, Regeneration, Analysis of regeneration data, Signal correction, Buffer scouting, Extracting kinetic affinity constant, Extracting kinetic rate constant, Sensor Surfaces and Receptor Depth, Molecular Interaction.		

UNIT - III	OPTICAL AND BIOCHEMICAL BIOSENSORS	9
Principles of Optical biosensing, Immobilization of bio-recognition elements, Types of optical biosensor: Fiber optic, planar waveguide, Evanescent, Interferometric, and Surface plasmon resonance-biosensor-Applications. Chemical and other sensors - Biocatalysis based biosensors, Bio affinity based biosensors & Microorganisms based biosensors, Biologically active material and analyte. Types of membranes used		

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in biosensor constructions.

UNIT - IV	IMMUNOSENSOR	9
introduction to Immuno biosensor- Enzyme Biosensor, Bio Affinity Biosensor, Labelled Immuno sensors, Non-Labelled Immuno sensors. Transducer Aspects of Immuno sensor Optical Immunosensor, Piezoelectric Crystal Immunosensors, Electrochemical Immunosensors. Biological Aspects of biosensor- Antibody Development, Immunosensor based Assay Development.		
UNIT - V	**DIAGNOSTIC APPLICATION OF BIOSENSOR**	**9**
Preparation of Doped Sol-Gel Glasses, Application of Sol-Gel Glasses in Biosensors- Glucose Biosensor, Urea Biosensor, Cholesterol Biosensor, Lactate Biosensor. Application of enzymes in analysis; design of enzyme electrodes and their application as biosensors in healthcare.		
Total Instructional hours : 45		

Course Outcomes: Students will be able to	
CO1	Apply principles and concepts of biology and engineering to design biosensors.
CO2	Apply principles and concepts of electronics and electrochemistry to design electrochemical biosensors.
CO3	Recognize different types of transducers, and their application in biosensor design.
CO4	Apply principles and concepts of sensing and engineering to design biosensors for detection of markers in biofluids.
CO5	Apply engineering tools to evaluate parameters needed for point-of-care devices.

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Text book	
1.	Bansi D Malhotra, Anthony, Advances in Biosensors, Volume 5, 2003, Elsevier, Oxford.
2.	Brian R Eggins - Biosensors an Introduction, First edition, John Wiley & Sons Publishers, 1996
3.	Loic J Blum, Pierre R Coulet - Biosensors Principles and Applications, First edition, Marcel Dekker,Inc, 1991.
4.	Donald G. Buerk - Biosensors Theory and Applications, First Edition Technomic Publishing. Co, Inc, 1993.

Reference Books	
1.	Elizabeth A Hall - Biosensors, First Edition, Open University, Milton Keynes, 1990.
2.	Graham Ramsay - Commercial Biosensors, First edition, John Wiley & Sons, Inc. 1998.
3.	Tran Minh Canh - Sensor Physics & Technology – Biosensors, First Edition, Champan & Hall, 1993.
4.	Mathew A.Cooper, Label free Biosensors Techniques and Applications, Cambridge, 2009.

Program Coordinator

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B. TECH.	B23BTO501 – BIOFERTILIZER PRODUCTION AND MUSHROOM CULTIVATION	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To provide a comprehensive understanding of the principles and practices of biofertilizer production and mushroom cultivation.
2.	To equip students with knowledge of microbial inoculants and their applications in sustainable agriculture.
3.	To explore the cultivation techniques and nutritional aspects of various edible mushrooms.
4.	To enable students to understand industrial mushroom processing, value addition, and quality control, including nutraceuticals and waste management.
5.	To familiarize students with the quality control and commercial aspects of biofertilizers and mushroom production.

UNIT - I	INTRODUCTION TO BIOFERTILIZERS AND MICROBIAL INOCULANTS	9

Introduction to biofertilizers: Significance and scope. Types of biofertilizers: Nitrogen-fixing, phosphate-solubilizing, potassium-mobilizing, and mycorrhizal biofertilizers. Microbial inoculants: *Rhizobium, Azotobacter, Azospirillum, Pseudomonas, Bacillus, Trichoderma*, and mycorrhizal fungi. Mechanisms of action of biofertilizers: Nitrogen fixation, phosphate solubilization, plant growth promotion. Carrier materials and their properties. Quality control of biofertilizers: Viability, purity, and efficacy testing.

UNIT - II	PRODUCTION TECHNOLOGY OF BIOFERTILIZERS	9

Isolation and characterization of effective microbial strains. Fermentation technology for biofertilizer production: Batch, fed-batch, and continuous fermentation. Scale-up and optimization of biofertilizer production. Formulation and packaging of biofertilizers. Storage and shelf-life of biofertilizers. Quality standards and FCO.

UNIT - III	MUSHROOM CULTIVATION: PRINCIPLES AND PRACTICES	9

Introduction to edible mushrooms: Nutritional and medicinal value. Cultivation techniques for various mushrooms: Oyster, button, shiitake, and milky mushrooms. Substrate preparation and sterilization. Spawn production and inoculation. Environmental control in mushroom cultivation: Temperature, humidity, and ventilation. Pest and disease management in mushroom cultivation.

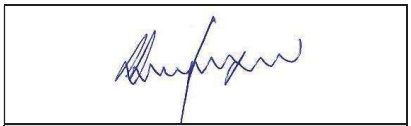
UNIT - IV	MUSHROOM PROCESSING AND VALUE ADDITION	9

Post-harvest handling and preservation of mushrooms. Processing of mushrooms: Drying, canning, and pickling. Value-added products from mushrooms: Mushroom powder, extracts, and nutraceuticals. Mushroom waste utilization. Quality assessment of mushrooms: Sensory, chemical, and microbiological analysis.

UNIT - V	COMMERCIAL ASPECTS AND ENTREPRENEURSHIP	9

Market potential and demand for biofertilizers and mushrooms. Economic analysis of biofertilizer and mushroom production. Entrepreneurial opportunities in biofertilizer and mushroom industries. Marketing and distribution strategies. Intellectual property rights (IPR) and patenting. Government schemes and subsidies.

Total Instructional hours : 45



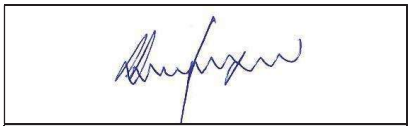
Approved by BoS Chairman

Course Outcomes After the successful completion of the course, the students will be able to,		Knowledge Level
CO1	Illustrate the principles of microbial inoculant production and application.	K2
CO2	Classify the different types of biofertilizers and their impact on soil fertility.	K2
CO3	Explain the cultivation techniques and nutritional value of various edible mushrooms.	K2
CO4	Demonstrate the quality and safety parameters of biofertilizers and mushroom products.	K2
CO5	Identify the commercial aspects and entrepreneurial opportunities in biofertilizer and mushroom industries.	K3

Text Books	
1.	Subba Rao N.S., "Soil Microbiology", Oxford & IBH Publishing Company, New Delhi, 2002.
2.	Himadri Panda H., "Manufacture of Biofertilizer and Organic Farming", Asia Pacific Business Press Inc., 2024.
3.	Tewari R.P., "Mushrooms: Cultivation, Marketing and Consumption", Daya Publishing House, Delhi, 2005.
4.	Chang S.T., Miles P.G., "Mushrooms: Cultivation, Nutritional Value, Medicinal Effect, and Environmental Impact", CRC Press, Boca Raton, 2004.

References Books	
1.	Alexander M., "Introduction to Soil Microbiology", John Wiley & Sons, New York, 1977.
2.	Stamets P., "Mycelium Running: How Mushrooms Can Help Save the World", Ten Speed Press, Berkeley, 2005.

CO-PO-PSO Mapping														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	2	2	-	-	2	3	3
CO2	2	1	-	-	-	-	-	2	2	-	-	2	3	3
CO3	2	2	-	-	-	-	-	2	2	-	-	2	3	3
CO4	2	2	-	-	-	-	-	2	2	-	-	2	3	3
CO5	2	2	-	-	-	-	-	2	2	-	-	2	3	3
Wt. Avg.	2	2	-	-	-	-	-	2	2	-	-	2	3	3



Approved by BoS Chairman

B.E.	B23CSO501- FOUNDATIONS OF DBMS (Except CSE)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To learn the fundamentals of data models, relational algebra and SQL.
2.	To represent a database system using ER diagrams and to learn normalization techniques.
3.	To understand the concepts of transaction, concurrency and recovery processing.
4.	To understand the internal storage structures using different file and indexing techniques
5.	To have basic knowledge about the Distributed databases, NOSQL and DB security

UNIT - I	RELATIONAL DATABASES	9

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL

UNIT - II	DATABASE DESIGN	9

Entity-Relationship model – ER Diagrams – Enhanced-ER Model – ER to Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

UNIT - III	TRANSACTIONS	9

Transaction Concepts – ACID Properties – Schedules – Serializability – Transaction support in SQL – Need for Concurrency – Concurrency control –Two Phase Locking- Timestamp – Multiversion – Validation and Snapshot isolation– Multiple Granularity locking – Deadlock Handling – Recovery Concepts – Recovery based on deferred and immediate update – Shadow paging – ARIES Algorithm.

UNIT - IV	IMPLEMENTATION TECHNIQUES	9

RAID – File Organization – Organization of Records in Files – Data dictionary Storage – Column Oriented Storage– Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for Selection, Sorting and join operations – Query optimization using Heuristics - Cost Estimation.

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UNIT - V	ADVANCED TOPICS	9
Distributed Databases: Architecture, Data Storage, Transaction Processing, Query processing and optimization – NOSQL Databases: Introduction – CAP Theorem – Document Based systems – Key value Stores – Column Based Systems – Graph Databases. Database Security: Security issues – Access control based on privileges – Role Based access control – SQL Injection – Statistical Database security – Flow control – Encryption and Public Key infrastructures – Challenges.		
Total Instructional hours: 45		

Course Outcomes: Students will be able to	
CO1	Construct basic SQL Queries using relational algebra
CO2	Build database using ER model and normalize the database
CO3	Organize transaction-related queries while ensuring consistency and concurrency control
CO4	Evaluate various indexing and file organization strategies to optimize query performance
CO5	Analyze relational DB and NoSQL DB

Text Books	
1.	Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Seventh Edition, McGraw Hill, 2020.
2.	Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education, 2017.

Reference Books	
1.	C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.

Approved by BoS Chairman

CO Mapping with PO & PSO

CO/PO & PSO		PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K6)	PO6 (K3) (A3)	PO7 (K2) (A3)	PO8 (K3) (A3)	PO9 (A3)	PO10 (A3)	PO11 (K3) (A3)	PO12 (A3)	PSO1 (K4) (A3)	PSO2 (K3) (A3)
CO1	K3														
CO2	K3														
CO3	K3														
CO4	K5														
CO5	K4														
Weighted Average															

3 – Substantial **2- Moderate** **1- Low** **'-' – No Correlation**

Approved by BoS Chairman

B.E / B. TECH	B23ECO501 COMMUNICATION ENGINEERING (Common to All Except ECE)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the concepts of modulation techniques in generation of amplitude modulation and angle modulation.
2.	To impart knowledge in random process
3.	To familiarize students' optimum receivers for binary digital modulation schemes
4.	To examine digital modulation formats and their power spectral
5.	To understand the properties of spread spectrum techniques to design robust and efficient communication systems

UNIT – I FUNDAMENTALS OF ANALOG COMMUNICATION	9
Basics of communication systems; Fundamentals of Principles of amplitude modulation; AM envelope; frequency spectrum and bandwidth; modulation index and percent modulation; AM Voltage distribution; AM power distribution; Angle modulation; FM and PM waveforms; phase deviation and modulation index; frequency deviation and percent modulation; Frequency analysis of angle modulated waves; Bandwidth requirements for Angle modulated wave.	

UNIT–II RANDOM PROCESS AND SAMPLING	9
Review of probability and random process; Gaussian and white noise characteristics; Noise in amplitude modulation systems; Noise in Frequency modulation systems; Pre-emphasis and Deemphasis; Threshold effect in angle modulation; Low pass sampling; Aliasing; Signal Reconstruction; Quantization; Uniform & non-uniform quantization; quantization noise; Nyquist criterion; Logarithmic Companding; PAM; PPM; PWM; PCM; TDM; FDM.	

UNIT – III DIGITAL TRANSMISSION	9
Optimum Receiver for Binary Digital Modulation Schemes; Description of Binary ASK; PSK; and FSK Schemes; Binary PSK Signaling Schemes; M-ary Signaling Schemes; Synchronization Methods.	

UNIT – IV DIGITAL MODULATION TECHNIQUES	9
Digital modulation formats; Coherent Binary Modulation Techniques: BFSK and BPSK; QPSK; MSK; M-ary QAM; Power spectra of BFSK; BPSK; QPSK and MSK.	
UNIT – V SPREAD SPECTRUM AND MULTIPLE ACCESS	**9**

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PN sequences: properties; m-sequence; DSSS; Processing gain; Jamming; FHSS; Synchronization and tracking; Multiple Access: FDMA; TDMA; CDMA.
Total Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Apply principles of basic communication systems to design basic modulation schemes for efficient signal transmission.
CO2	Apply probability and random process principles to analyze noise in communication systems
CO3	Apply knowledge to design and assess optimum receivers for binary digital modulation schemes like ASK, PSK, FSK, and M-ary systems.
CO4	Analyze and differentiate between digital modulation formats and their power spectral.
CO5	Apply and evaluate concepts of PN sequences, DSSS, FHSS, and multiple access techniques

Text Books	
1.	K Sam Shanmugam, Digital and Analog Communication Systems, Wiley, 2019.
2.	Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2018.
3.	Simon Haykin, "Communication Systems", Wiley India, 4th edition, 2014.

Reference Books	
1.	H.Taub, D L Schilling and G Saha, "Principles of Communication", 4th Edition, Pearson Education, 2017.
2.	B.P.Lathi, Zhi Ding, Hari Mohan Gupta "Modern Analog and Digital Communication Systems", 4th Edition, Oxford University Press, 2017.
3.	Sanjay Sharma, "Communication Systems (Analog and Digital)", S.K. Kataria & Sons; Reprint 2013.
4.	B.Sklar, "Digital communications: Fundamentals and Applications", 2nd Edition, Pearson Education, 2012.

<table>
<tr><th colspan="5">Evaluation Pattern:</th></tr>
<tr><th colspan="4">Continuous Internal Assessment</th><th>End Semester Examinations</th></tr>
<tr><td colspan="2">CIA I (Theory)
(100 Marks)</td><td colspan="2">CIA II (Theory)
(100 Marks)</td><td rowspan="3">Theory End Semester Examinations
(Examinations will be conducted for 100 Marks)</td></tr>
<tr><td>* Alternate Assessment Tool (AAT)</td><td>Written Test</td><td>* Alternate Assessment Tool (AAT)</td><td>Written Test</td></tr>
<tr><td>40 Marks</td><td>60 Marks</td><td>40 Marks</td><td>60 Marks</td></tr>
<tr><td colspan="4">40 Marks</td><td>60 Marks</td></tr>
<tr><td colspan="5">Total: 100 Marks</td></tr>
</table>

* AAT - Individual Assignment/ Case Study/ Seminar/ Mini project/ MCQ/ Role Play/ Group Discussion/ Debates/ Oral Presentations/ Poster Presentations/ Technical Presentations can also be provided course coordinator can choose any one/two components based on the nature of the course.

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B.E	B23EEO501- ELECTRIC VEHICLE TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of electric vehicle history and components.
2.	To understand properties of batteries.
3.	To understand the electrical machine properties and classifications.
4.	To understand the properties of electric vehicle drive systems.
5.	To understand the concepts of hybrid electric vehicles.

UNIT-I	INTRODUCTION TO ELECTRIC VEHICLES	9

Present scenario of electric vehicles, Need of electric vehicles, economics, environmental impacts of using electric vehicles, challenges faced by electric vehicles in replacing ICE, major requirements of electric vehicles.

UNIT-II	TYPES OF ELECTRIC VEHICLES AND THE CHALLENGES	9

Types of electric vehicles: Plug-in Electric Vehicle (PEV), Battery Electric vehicle (BEV), Fuel Cell electric vehicle (FCEV), Hybrid electric vehicle (HEV), Challenges of battery electric vehicle, hybrid electric vehicle and fuel cell electric vehicle.

UNIT-III	BATTERY ELECTRIC VEHICLE	9

Components of BEV drive train: electric propulsion subsystem - power converter, driving wheels, suspension system, driveshaft, mechanical transmission, electric Motor, power electronics converters (DC-AC/DC-DC), electronic control unit, energy source subsystem, battery pack with battery management system, On board charger, auxiliary subsystem, power steering unit, common parts between ICE drive train and EV drive train.

UNIT-IV	HYBRID AND FUEL CELL ELECTRIC VEHICLE	9

Basic architecture of hybrid drive trains, components of HEV drive train system, classification of HEV: conventional HEV (Micro, Mild and Full hybrid- series hybrid, parallel hybrid, series-parallel hybrid, complex hybrid), Basic architecture of FCEV, components of FCEV drive train system.

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UNIT-V	ENERGY STORAGE	9
Battery-based energy storage, Overview of batteries, Battery parameters, battery charging, regenerative braking, alternative novel energy sources: solar photovoltaic cells, fuel cells, super capacitors, and flywheels.		
		Total Instructional hours:45

Course Outcomes: **Students will be able to**	
CO1	Illustrate the basics of electric vehicle history and components.
CO2	Classify the different types of electric vehicles.
CO3	Apply the battery properties in an electric vehicle.
CO4	Develop the hybrid and fuel cell electric vehicle.
CO5	Illustrate the concept of energy storage devices.

Text Books	
1.	Electric & Hybrid Vehicles – A.K. Babu, Khanna Publishing House, New Delhi, 2018.
2.	Electric & Hybrid Vehicles – Design Fundamentals – Iqbal Hussain, Second Edition, CRC Press, 2011.
3.	Electric Vehicle Battery Systems – Sandeep Dhameja, Newnes, 2000.
4.	Husain, I. (2021). Electric and Hybrid Vehicles: Design Fundamentals (3rd Edition). CRC Press.

Reference Books	
1.	Electric Vehicle Technology Explained - James Larminie, John Wiley & Sons, 2003
2.	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals – Mehrdad Ehsani,Yimin Gao, Ali Emadi, CRC Press, 2010.
3.	Chan, C. C., & Chau, K. T. (2001). Modern Electric Vehicle Technology. Oxford University Press.
4.	Larminie, J., & Lowry, J. (2023). Electric Vehicle Technology Explained (3rd Edition). Wiley.

Approved by BoS Chairman

B.E.	B23MEO501 - ROBOTICS	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the concepts of the basic components of a robot
2.	To apply the distinct drive systems and end effectors to control the robot actuation
3.	To study the role and application of various types of sensors and machine vision system
4.	To make use of the knowledge in the robot kinematics and to write Robot Programs
5.	To identify the social and economic challenges while implementing the robot systems

UNIT - I	FUNDAMENTALS OF ROBOT	9

Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification - Specifications - Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load - Robot Parts and their Functions- Different Applications - A view on Global and Indian manufacturers of Robots - Need for Robots in Indian environment.

UNIT - II	ROBOT DRIVE SYSTEMS AND END EFFECTORS	9

Drives - hydraulic, pneumatic, mechanical, electrical, Servo motors, Stepper motors - salient features, application; End effectors – types; Grippers - mechanical, pneumatic, hydraulic, magnetic, vacuum - limitations, Multiple grippers.

UNIT - III	SENSORS AND MACHINE VISION	9

Requirements of sensors, principles, types and applications of Proximity (Inductive, Hall effect, Capacitive, Ultrasonic and Optical); – Range (Triangulation, Structured light approach); Speed, Position (resolvers, optical encoders); – Force – Torque – Touch sensors (binary, analog sensor). Introduction to Machine Vision; applications, functions; image processing and analysis; training the vision system.

UNIT - IV	ROBOT KINEMATICS AND ROBOT PROGRAMMING	9

Forward kinematics and Reverse kinematics of manipulators; two, three degrees of freedom, homogeneous transformation matrix; introduction to manipulator dynamics, trajectory generator, manipulator mechanism, Degeneracy and Dexterity; Lead through programming, Robot programming languages; VAL programming, motion commands, sensor commands, end effecter commands, simple programs (for loading, unloading and palletizing operations), introduction to advances in Robot Programming.

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UNIT - V	APPLICATION, IMPLEMENTATION AND ROBOT ECONOMICS	9
Robot cell design; types, application of robots in processing, assembly, inspection, material handling in automobile, medical, Nuclear Industries, RGV, AGV; Implementation of Robots in Industries; Safety considerations for robot operations, safety codes, Economic analysis of robots.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the concepts of industrial robots, classification, specifications and coordinate systems.
CO2	Illustrate the different types of robot drive systems as well as robot end effectors.
CO3	Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
CO4	Develop robotic programs for different operations and familiarize with the kinematics motions of robot.
CO5	Examine the implementation of robots in various industrial sectors and interpolate the economic analysis of robots.

Text Books	
1.	Groover M.P., “Industrial Robotics - Technology Programming and Applications”, McGraw Hill, 2012.
2.	Deb S R and Deb S, Robotics Technology and Flexible Automation, Tata McGraw Hill Education Pvt. Ltd, 2010.
3.	Saha S K, Introduction to Robotics, Tata McGraw Hill Education Pvt. Ltd, 2010, 2nd Ed, 2014.

Reference Books	
1.	Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, Global Edition, 3rd Edition, 2014.
2.	Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 2013.
3.	Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis, Oxford University Press, Sixth impression, 2010.

Approved by BoS Chairman

B.E / B.TECH	B23CBO501 FRONT END DEVELOPMENT	T	P	TU	C
		3	0	1	3

Course Objectives	
1.	To interpret the basics of front end development and modern development tools.
2.	To device a front end design with HTML Tags.
3.	To work with HTML Forms and Implement Layouts Using Frames and iFrames
4.	To design a dynamic webpage using CSS.
5.	To articulate client side activities on a web site using Javascript.

UNIT- I	INTRODUCTION TO FRONT END DEVELOPMENT	9

Introduction to web - WWW - Web server and client, URL, URI,URN-Internet addresses and IP classes Web protocols -TCP/IP,UDP, MIME.SMTP,POP3,HTTP & HTTPS-MVC-Model, View, Controller of Web design-Role of front end developer and Modern Front end Tools.

UNIT-II	HTML (HYPERTEXT MARKUP LANGUAGE)	9

Introduction to HT ML - HTML s HTML5 - Basic HTML Structure - HTML Elements, Attributes and properties - Formatting tags - Lists & symbols -Ordered Lists -Unordered Lists- Descriptive Lists - Hyperlinks- Multimedia: Images, Audio, Video tags

UNIT- III	HTML TABLES & FORMS	9

HTML table :Table border, row, column header, rowspan & colspan, cell spacing and cell padding HTML forms: Form elements- Text, Textarea, Password field, Label-Checkbox, Radio Button. Selection List - Button -Frames & iFrames

UNIT- IV	CSS (Cascading style sheets)	9

Introduction to style sheets: Cascading style sheets-CSS properties - CSS selectors - Pseudo classes and elements - Types of CSS: Inline, Embedded, External style sheet-Case study Talwind CSS

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UNIT- V CLIENT SIDE SCRIPTING	9
Introduction to Javascript, Javascript features -Datatypes, Variables , Literals & Operators – Control structures -Arrays - Predefine functions & User defined functions – Javascript - DOM objects - Case study- npm, NodeJs.	
Total Instructional hours: 45	

Course Outcomes: Students will be able to	
CO1	**Interpret the working of web sites, web servers and modern front-end**
CO2	Build web pages of a website with HTML
CO3	Develop web site for process and Implement Layouts Using Frames and
CO4	Construct dynamic styles using CSS.
CO5	Build client side activities with Javascript.

Text Books:

1.Uttam K.Roy,"Web Technologies" by, Oxford University Press 2010, First edition, eight impression 2014.

Reference Books :

1.Thomas Powell , "HTML& css: The Complete Reference", Fifth Edition Paperback - 1, Tata McGrawHill, July 2017.

2.. Laurence Lars Svekis , Maaike Van Putten , Rob Percival ," JavaScript from Beginner to Professional: Leam JavaScript quickly by building fun, interactive, and dynamic web apps. games, and pages", Packt, December 2021.

Approved by BoS Chairman

Open Elective - II

B.E.	B23AEO601 – UNMANNED AIRCRAFT SYSTEMS OPERATION AND MRO (Common to all Except AERO)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To know the working principles of aircraft engine and fuel systems.
2.	To understand the lighting technologies and pressurization system of the aircraft cabin.
3.	To realize the warning and protection systems of the aircraft.
4.	To expose on terrain warning systems of the safety of the aircraft.
5.	To gain knowledge on FDR and anti-fire protection system.

UNIT - I	DRONE RULES & BASIC PRINCIPLES OF FLIGHT	9

International Rules- Regulations, Standards & Practices, Dos and Do not, Civil Aviation Requirements- AIPs, NOTAM, Classification & Categorization of drones, Type Certification of Drones, Registration, Sale & De-Registration of Drones, Operations of Drones, Dos and Donts, Remote Pilot Licensing, Drone Insurance Fundamentals of flight, Aerodynamics, Take-off, flight, and landing. Maneuvers, turns and circuit pattern.

UNIT - II	ATC PROCEDURES & RADIO TELEPHONY (NON FRTOL) WEATHER AND METEOROLOGY	9

Understanding ATC operations, Airspace structure and Airspace, Restrictions with knowledge of no drone zones, RT Phraseology & Communicating with ATC including Position and Altitude Reporting. Flight Planning Procedures including Altimeter setting procedures. Collision avoidance. Radio Telephony (RT) techniques, The standard atmosphere, Measuring air pressure, Heat and temperature, Wind. Moisture, cloud formation, icing and its effects. Effect of atmosphere on RPAS operation & hazardous weather avoidance, Met Terminal Aviation Routine Weather Report (METAR).

UNIT - III	FIXED-WING & ROTORCRAFT OPERATIONS AND AERODYNAMICS	9

Types of fixed wing drones, make, parts, terminology, Operation and maneuvers of fixed wing drones, Flight Performance. Intro to Mission Planning, Instrument Flying & Navigation (GCS). Applications of fixed-wing UAVs. Pros and Cons of Fixed Wing Drones Rotorcraft- Basic drone terminology & parts,

Programme Coordinator

BoS Chairman

Types of drones, material used and size of drones, Drone Anatomy: Different parts of drones, Avionics & C2 Link, Intro to Mission Planning, Instrument Flying & Navigation (GCS). Applications and operations of Multirotor, Flight Performance. Pros and Cons of Rotorcraft Drones.

UNIT - IV	HYBRID OPERATIONS, AERODYNAMICS & EQUIPMENT MAINTENANCE	9
Principles of Aerodynamics, Types of Hybrid Drones & Parts, Intro to Mission Planning, Instrument Flying & Navigation (GCS), Applications of Hybrid UAVs, Comparison with Rotorcraft & Aeroplane Drone Equipment Maintenance- Maintenance of drone, flight control box, ground station, Maintenance of ground equipment, batteries and payloads, Scheduled servicing, Repair of equipment, Fault finding and rectification.		

UNIT - V	SAFETY MANAGEMENT, PAYLOAD, & DATA & ANALYSIS	9
Drothe Emergency & Handling, Loss of C2-link, Fly-aways (Straying), Loss of power, Other Emergencies, Control surface failures, Human Performance & Pilot Incapacitation, Fail-Safe Features, Types of payloads - What to carry, what not to carry, Parts of payloads, Installation, Features of payloads, Utilization, Principles of Observation, Elements of Image & Video Interpretation, Introduction to Photogrammetry, Types of Image & Video Data, Analysis.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the Basics of Ignition and Fuel System of an Aircraft. (K2)
CO2	Illustrate the Flight Compartment Lighting Technologies and Cabin Air Conditioning system. (K2)
CO3	Identify the Warning and Protection Systems for the Ice Formation and Rain in the Airframe of the Aircraft During Flight. (K3)
CO4	Apply the Terrain Warning Systems to avoid the Terrain Collision of an Aircraft. (K3)
CO5	Examine the FDR and Fire Protection System to Monitor the Flying Performance of the Aircraft. (K4)

Text Books	
1.	“Aircraft Electrical and Electronic Systems”, Principles, operation and maintenance by Mike Tooley and David Wyatt.

Programme Coordinator	**BoS Chairman**

Reference Books	
1.	Pallet.E.H.J., "Aircraft Instruments and Integrated Systems", Pearsons, Indian edition 2011.
2.	Spitzer, C.R. "Digital Avionics Systems", Prentice-Hall, Englewood Cliffs, N.J., U.S.A. 1993.
3.	Spitzer. C.R. "The Avionics Hand Book", CRC Press, 2000.

Programme Coordinator

BoS Chairman

B.Tech.	B23AGO601 - Environmental Management in Agriculture	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To provide knowledge on natural resource use and environmental sustainability in agriculture.
2.	To understand the causes and impacts of pollution from agricultural activities.
3.	To explore the principles and methods of environmental impact assessment (EIA).
4.	To study the role of waste management and resource recycling in agriculture.
5.	To introduce climate-smart agriculture and mitigation strategies for sustainable development.

UNIT I	NATURAL RESOURCES AND SUSTAINABILITY	9

Natural resources – classification and utilization in agriculture – Sustainable use of soil, water, biodiversity – Ecological footprint – Concept of carrying capacity – Environmental indicators – Role of agriculture in environmental degradation – Policies for sustainable agriculture – SDGs related to environment and agriculture.

UNIT II	AGRICULTURE AND POLLUTION	9

Agricultural pollution – causes and effects – Soil pollution due to fertilizers, pesticides and heavy metals – Water pollution: runoff, eutrophication, groundwater contamination – Air pollution: burning of residues, methane, ammonia emissions – Noise pollution from farm machinery – Agrochemical residues and food chain contamination – Preventive strategies.

UNIT III	ENVIRONMENTAL IMPACT ASSESSMENT (EIA)	9

Concept and need for EIA – Components and stages of EIA – Screening, scoping, impact prediction, mitigation – EIA methods (checklist, matrix, network) – Public participation – Environmental Management Plan (EMP) – Environmental audit – Case studies of agricultural projects (dams, irrigation, fertilizer units).

UNIT IV	AGRICULTURAL WASTE AND RESOURCE MANAGEMENT	9

Types of agricultural waste – crop residues, livestock waste, agro-industrial waste – Collection, handling and disposal – Waste minimization – Composting, vermicomposting, biogas production – Biomass energy – Circular economy in agriculture – Integrated farming and nutrient recycling – Wastewater reuse in agriculture.

UNIT V	CLIMATE CHANGE AND SUSTAINABLE FARMING	9

Climate change: causes and impact on agriculture – GHG emissions from agriculture – Carbon sequestration – Climate-smart agriculture – Conservation agriculture – Precision farming – Agroforestry and carbon farming – Green technologies in agriculture – Institutional frameworks (UNFCCC, IPCC, ICAR).

Total Instructional Hours: 45

COURSE OUTCOMES: Students will be able to

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CO1	Understand the sustainable use of natural resources in agriculture.
CO2	Identify environmental pollution sources and their impact from agriculture.
CO3	Apply EIA techniques for environmental planning in agricultural projects.
CO4	Utilize waste management techniques for environmental protection.
CO5	Implement climate-resilient and sustainable agricultural practices.

Text Books	
1.	Rattan Lal and B.A. Stewart, *Soil and Environmental Management*, CRC Press, 2020.
2.	N.T. Kumbhar, *Environmental Management in Agriculture*, Himalaya Publishing House, 2018.
3.	G.N. Tiwari and R.K. Mishra, *Environmental Pollution and Management*, Narosa Publishing House, 2015.

References	
1.	D.W. Sims, *Agricultural Waste Management*, FAO Publications.
2.	Shukla, S.K. & Pandey, P., *Climate Smart Agriculture*, Springer, 2021.
3.	EIA Guidelines – Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India.
4.	NPTEL: https://nptel.ac.in/courses/120108004

Approved by BoS Chairman

B.E/ B.TECH	B23ADO601-HUMAN COMPUTER COMMUNICATION	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To outline the basic knowledge of HCI.
2.	To classify the design process and rules.
3.	To apply the evaluation techniques and HCI models.
4.	To make use of communications and human factors.
5.	To develop the understanding of user interface.

UNIT - I	INTRODUCTION TO HCI	9

Introduction to HCI - A discipline involved in HCI- Importance of HCI - The psychology of everyday things - Principles of HCI - Input–output channels - Human memory -Thinking: reasoning and problem solving - Conceptual Models – Interface Metaphors – Interaction Types – Paradigms and Frameworks. Cognitive Aspects: Cognition – Cognitive Framework. Social Interaction – Emotional Interaction.

UNIT - II	HCI DESIGN PROCESS AND DESIGN RULES	9

The software design process - User focus – Scenarios - Navigation Design - Screen Design - Prototyping techniques - Wire-Framing - Understanding the UI Layer and Its Execution Framework, Model-View-Controller(MVC) Framework - Principles that support usability, Design standards, Design Guidelines, Golden rules and heuristics, User interface management system (UIMS).

UNIT - III	EVALUATION TECHNIQUES AND HCI MODELS	9

Goals of evaluation - Evaluation Criteria - Evaluation through expert analysis - Evaluation through user participation - Choosing an Evaluation Method - Goal and task hierarchy model - Linguistic model - Physical and device models - Cognitive architectures - Hierarchical task analysis (HTA) - Uses of task analysis - Diagrammatic dialog design notations - Computer mediated communication - Ubiquitous Computing.

Approved by BoS Chairman

UNIT - IV	COMMUNICATION AND HUMAN FACTORS	9
Face-to-face Communication - Conversation - Text-based Communication - Group working - Dialog design notations - Diagrammatic notations - Textual dialog notations - Dialog semantics - Dialog analysis and design – Groupware - Meeting and decision support systems - Shared applications and artifacts - Frameworks for groupware Implementing synchronous groupware - Mixed - Augmented and Virtual Reality.		

UNIT - V	FUTURE OF HCI AND USER INTERFACE	9
The future of HCI - perceptual interfaces, context-awareness and perception –User centered design - Interfaces: Types – Natural User Interfaces, Importance of user Interface and good design - Principles of user interface. - The graphical user interface – popularity of graphics, the concept of direct manipulation - graphical system - Characteristics - Web user – Interface popularity.		
Total Instructional hours: 45		

Course Outcomes: Students will be able to	
CO1	Illustrate the importance of human computer interaction.
CO2	Explain the design process and design rules.
CO3	Develop the understanding of evaluation techniques and HCI models.
CO4	Demonstrate the concept of communication and human factors.
CO5	Apply the user centered deign methods.
Text Books	
1.	A Dix, Janet Finlay, G D Abowd, R Beale., Human-Computer Interaction, 3rd Edition, Pearson Publishers,2018
2.	Wilbert O. Galitz, “The Essential Guide to User Interface Design: An Introduction to Gui Design Principles and Techniques”, Third Edition, John Wiley Sons, 2017..
Reference Books	
1.	Sharp, H., Rogers, Y., and Preece, J, “Interaction Design: Beyond Human – Computer Interaction”, Third Edition, John Wiley & Sons, Inc., 2021.
2.	Shneiderman, Plaisant, Cohen and Jacobs, Designing the User Interface: Strategies for Effective Human Computer Interaction, 5th Edition, Pearson Publishers, 2020.

Approved by BoS Chairman

B.E / B.Tech	B23AMO601 - AI FOR SMART SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To recall the different types of AI based on capabilities and functionality
2.	To discuss the ethical implications of AI and how they affect societal impact
3.	To analyze a case study of AI-enhanced weather forecasting and evaluate its effectiveness in agricultural applications
4.	To evaluate the potential future trends and ethical dilemmas in the integration of AI in healthcare and autonomous systems
5.	To design a functional interactive AI system, such as a food delivery app, integrating AI technologies like voice recognition and user interaction design

UNIT - I	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	9

Basics of AI: Definition and origins - Intelligence and its measurement - History and evolution of AI technologies - Overview of AI applications in smart systems - Types of AI: Based on Capabilities and Functionality - The Role of Ethics in AI Governance - Symbolic AI vs. Connectionist AI - Autonomous Vehicles and Intelligent Transportation Systems

UNIT – II	AI METHODOLOGIES AND TECHNIQUES	9

Introduction to Robotics and AI – Ethics of AI – Machine learning basics – Supervised learning - Unsupervised learning – AI in smart homes - Impact of AI in society

UNIT – III	ADVANCED AI TOPICS	9

Soft Computing: Overview and applications - Chat Bots and Conversational AI: Design and development - AI in Cyber-Physical Systems: Integration and challenges - AI-enabled IoT: Concepts – Case study : Agriculture: AI-Enhanced Weather Forecasting

UNIT – IV	APPLICATIONS OF AI IN SMART SYSTEMS	9

AI in Healthcare: Diagnostics and personalized medicine - AI in Automotive Systems: Autonomous vehicles - AI in Robotics: Intelligent control and navigation - Ethical considerations and future trends in AI

UNIT – V	INTERACTIVE AI SYSTEM DESIGN	9

Fundamentals of Human-AI Interaction - Role of AI in personal assistants – Interactive AI in customer service – AI in Education – Voice recognition systems - Future Trends in Interactive AI Design - Case Study: Designing an Interactive Food Delivery App

Total Instructional hours: 45

Approved by BoS Chairman

Course Outcomes : Students will be able to	
CO1	Recall the definition and origins of AI, including its historical evolution and types based on capabilities and functionality.
CO2	Apply AI methodologies, such as machine learning, to analyze and solve problems in smart home systems.
CO3	Evaluate the effectiveness of AI in solving real-world problems.
CO4	Discuss the ethical considerations and predict future trends in the development of AI technologies.
CO5	Analyze trends in the future of interactive AI design, including advancements in voice recognition systems and their potential impact on different sectors.

Text Books	
1.	Khan, I. U., Ouaissa, M., Ouaissa, M., Fayaz, M., & Ullah, R., Artificial Intelligence for Intelligent Systems: Fundamentals, Challenges, and Applications, CRC Press, 1st Edition, 2024.
2.	Ramana, T. V., Ghantasala, G. S. P., Sathiyaraj, R., & Khan, M., Artificial Intelligence and Machine Learning for Smart Community, CRC Press, 1st Edition, 2023.

Reference Books	
1.	P, M., Kumar, M. V., & Umamaheswari, R., Machine Learning and IoT for Intelligent Systems and Smart Applications, CRC Press, 1st Edition, 2022.
2.	Venkatesh, C., Rengarajan, N., Ponmurugan, P., & Balamurugan, S., Smart Systems for Industrial Applications, Scrivener Publishing, 1st Edition, 2022.
3.	Tanwar, R., Bhatia, S., Sapra, V., & Ahuja, N. J. (Eds.). (2024). Artificial Intelligence and Machine Learning: An Intelligent Perspective of Emerging Technologies. CRC Press.
4.	Kose, U., Prasath, V. B., Mondal, M., Podder, P., & Bharati, S. (Eds.). (2022). Artificial Intelligence and Smart Agriculture Technology. *Auerbach Publications.*

Approved by BoS Chairman

B.E / B.Tech	BM23BMO601- MEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the electrode behavior and amplifiers
2.	To gain knowledge of various biopotential measurement
3.	To familiarize various electrical and non-electrical physiological parameters.
4.	To learn biochemical measurement
5.	To learn recent trends for biomedical applications

UNIT - I	BIOPOTENTIAL ELECTRODES AND AMPLIFIERS	9

Cell potential- Resting and Action potential, Electrode Electrolyte Interface, Types of electrodes, Bio signal characteristics– frequency and amplitude ranges, Bioamplifier, isolation amplifiers – transformer and optical isolation, Artifacts and removal.

UNIT - II	BIOPOTENTIAL MEASUREMENT	9

ECG – Einthoven 's triangle, standard 12 lead system, block diagram. Measurement of heart sounds - PCG. EEG – 10-20 electrode system, unipolar, bipolar and average mode, Functional block diagram. EMG – unipolar and bipolar mode, block diagram, EOG and ERG

UNIT - III	PHYSIOLOGICAL PARAMETER MEASUREMENT	9

Temperature, Respiration rate and pulse rate measurements, Plethysmography, Pulse oximetry, Blood Pressure measurement-direct and indirect method. Blood flow - Ultrasound blood flow measurement. Cardiac output measurement- Indicator dilution, dye dilution and thermodilution method, GSR Measurement, Patient Monitoring system

Program Coordinator

Approved by BOS Chairman

UNIT - IV	BIOCHEMICAL MEASUREMENT	9
Blood gas Analyzer, Blood Glucose measurement, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyser.		
UNIT - V	**RECENT TRENDS**	**9**
Point of care devices, Endoscopy unit, Radio pill, laproscopy, Applications of Laser in medicine, cryogenic application. Biotelemetry, Telemedicine, m-health.		
Total Instructional hours : 45		

Course Outcomes: Students will be able to	
CO1	Understand the electrode behavior
CO2	Comprehend the fundamentals of Bio potential recording.
CO3	Design various bio amplifiers
CO4	Measure various electrical and non-electrical physiological parameters.
CO5	Understand different monitoring system

Text book	
1.	Joseph J. Carr and John M. Brown, “Introduction to Biomedical equipment technology”,Pearson Education, 4th Edition, 2014.
	John G.Webster, “Medical Instrumentation Application and Design”, John Wiley and and Sons,New York, 4th Edition, 2009.

Program Coordinator

Approved by BOS Chairman

Reference Books	
1.	Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi,3 rd Edition, 2014.
2.	Richard Aston, “Principles of Biomedical Instrumentation and Measurement” Merril PublishingCompany, 1990.
3.	L.A Geddes and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, 3 rd Edition,John Wiley and Sons, Reprint 2008.

Program Coordinator

Approved by BOS Chairman

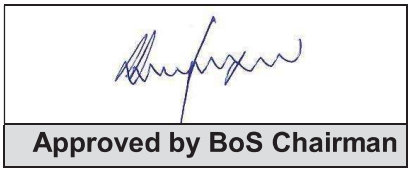
B. Tech.	B23BTO601 – BIOINFORMATICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To know the knowledge of databases and its maintenance.
2.	To provide the basic concept of various algorithms
3.	To deliver the knowledge on protein designing and its interactions.

Pre-requisite (if any)
Biochemistry, Molecular Biology, Protein Engineering

UNIT 1	INTRODUCTION TO BIOINFORMATICS	9
Scope of Bioinformatics, Databases- DBMS, Biological databases-classification-importance, Sequence Databases- GenBank, NCBI, DDBJ, EMBL, UniProt, SWISS-PROT, PIR, TrEMBL, Structural Databases-PDB, SCOP, CATH, pfam.		
UNIT 2	**SEQUENCE ANALYSIS**	**9**
Sequence Alignment- Sequence Homology Vs Sequence Identity Vs Sequence Similarity, Types of Sequence alignment methods- PSA, MSA, Scoring Function and Substitution Matrices-PAM & BLOSUM, Algorithms-Needleman-Wunch & Smith-Watermann, BLAST and its types, FASTA.		
UNIT 3	**PHYLOGENETIC RELATIONSHIPS**	**9**
Introduction to Phylogenetics-Parts of Phylogenetic Tree-Types of trees, Molecular Clock Theory, Distance Based Method- UPGMA, NJ, Character Based Method- Maximum Parsimony Method, Maximum Likelihood Method, Method of evaluating phylogenetic tree- Bootstrapping, Jackknife resampling, Data perturbation.		
UNIT 4	**STRUCTURAL ANALYSIS**	**9**
Protein Structure Visualization, Structural Prediction- Primary structure & Secondary Structure, tertiary Structure-Homology Modelling, Hidden Markov Model, Threading, Ab-initio method, Validation by Ramachandran plot.		
UNIT 5	**APPLICATIONS**	**9**
System Biology-Introduction and its importance, Microarray Data analysis, Approaches to drug designing and discovery.		
Total Instructional Hours: 45		

Course Outcomes After the successful completion of the course, the students will be able to,		Knowledge Level
CO1	Examine various biological databases.	K4
CO2	Compare genomic and proteomic sequences using various bioinformatics tools.	K5
CO3	Measure the evolutionary relationship using phylogenetic methods	K5
CO4	Compare vast genomic and proteomic dataset.	K5
CO5	Develop basic bioinformatics scripts with Perl programming.	K6



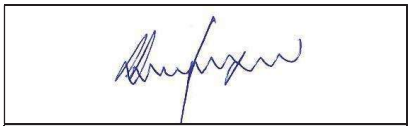
Approved by BoS Chairman

Text Books	
1.	Introduction to Bioinformatics by Arthur K. Lesk, Oxford University Press. ,4th edition 2014
2.	Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press. 1999
3.	Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by R.Durbin, S.Eddy, A.Krogh, G.Mitchison, Cambridge University Press. 2013
4.	Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press. 2nd edition, 2004.

Reference Books	
1.	Next Generation Sequencing Data Analysis, by Xinkun Wang CRC Press 2016

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	2	3	3	3	2	3	3	2	3
CO2	3	2	3	3	2	2	2	3	1	3	3	3	3	2
CO3	3	3	2	2	3	3	2	2	2	3	2	2	3	3
CO4	2	3	2	3	3	3	3	3	2	2	2	3	2	3
CO5	3	3	3	2	2	3	2	3	3	3	3	3	2	2
Wt. Avg.	**2.8**	**2.6**	**2.6**	**2.4**	**2.6**	**2.6**	**2.4**	**2.8**	**2.2**	**2.6**	**2.6**	**2.8**	**2.4**	**2.6**



Approved by BoS Chairman

B.E.	B23CSO601- FOUNDATIONS OF WEB DEVELOPMENT (Except CSE)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the structure of websites and fundamental web technologies such as HTML5 and CSS3.
2.	To understand basic programming concepts using Java for web development.
3.	To explore dynamic client-side functionalities using JavaScript and DHTML.
4.	To identify the role of server-side programming and databases in web applications.
5.	To apply web development knowledge for building basic interactive applications.

UNIT - I	BASICS OF WEB	9

Basics of Internet – Web Clients and Servers – HTTP Protocol – Web Communication. HTML5: Tags, Forms, Tables, Lists, Multimedia Integration (Audio, Video). CSS3: Styling Text and Layout – Inline, Embedded, External Style Sheets – Responsive Layout

UNIT - II	PROGRAMMING CONCEPTS	9

Need for Programming in Web Development – Java Overview – Simple Java Program Structure – Variables, Data Types, Operators, Control Structures – Arrays – Methods – Introduction to Classes and Objects (no inheritance). Use of Java in Web and GUI Applications

UNIT - III	JAVASCRIPT AND DYNAMIC WEB PAGES	9

JavaScript Basics: Variables, Operators, Conditional Statements, Loops – Functions. Working with Forms – Validations – DOM Manipulation – Popups and Events. DHTML: Combining HTML, CSS, JavaScript for Simple Interactions.

UNIT - IV	SERVER-SIDE PROGRAMMING BASICS	9

Overview of Server-Side Scripting – Introduction to Java Servlets – Servlet Lifecycle – Handling Form Data using GET and POST – Session Management – Basics of Cookies. Web Server Setup: Apache Tomcat (Overview and Setup).

UNIT - V	DB CONNECTIVITY AND APPLICATIONS	9

Basics of Database for Web – Introduction to JDBC – Connecting Java Applications to Databases – Sample Data Insertion and Retrieval – Use Cases in Industry and Healthcare Systems. Mini Case Study: Simple Web Application with Form Input and Database Storage.

Total Instructional hours: 45

Approved by BoS Chairman

Course Outcomes: Students will be able to	
CO1	Outline core components of web applications including HTML5 and CSS3.
CO2	Apply basic Java programming for developing interactive functionalities
CO3	Develop dynamic client-side interactions using JavaScript and DHTML
CO4	Explain the workflow of server-side programs and sessions using Java servlets
CO5	Construct a simple web application integrating frontend, server-side logic, and database

Text Books	
1.	Kogent Learning Solutions Inc., Web Technologies Black Book, Dreamtech Press, 2018.
2.	Budi Kurniawan, Servlet & JSP: A Tutorial, 2nd Edition, Brainy Software Inc., 2015.

Reference Books	
1.	Deitel P.J. & Deitel H.M., Internet and World Wide Web How to Program, Pearson Education, 2020.
2.	Jeffrey C. Jackson, Web Technologies: A Computer Science Perspective, Pearson Education, 2011.
3.	Herbert Schildt, Java: A Beginner's Guide, McGraw-Hill, 2018.

CO Mapping with PO & PSO

CO/PO & PSO		PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K6)	PO6 (K3) (A3)	PO7 (K2) (A3)	PO8 (K3) (A3)	PO9 (A3)	PO10 (A3)	PO11 (K3) (A3)	PO12 (A3)	PSO1 (K4) (A3)	PSO2 (K3) (A3)
CO1	K2														
CO2	K3														
CO3	K3														
CO4	K2														
CO5	K3														
Weighted Average															

3 – Substantial **2- Moderate** **1- Low** **'-' – No Correlation**

Approved by BoS Chairman

B.E / B. TECH	B23ECO601 - WIRELESS TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Understand Introduction about wireless Communication.
2.	Study the basic concepts of channel modeling.
3.	Learn the access schemes in wireless communication.
4.	Understand channel capacity in wireless communication system.
5.	Learn evolution of wireless technologies.

UNIT I INTRODUCTION	9
Introduction to wireless communication systems-Cellular concept – system design fundamentals Handoff Strategies- Interference and system capacity, Improving Coverage and Capacity	

UNIT II CHANNEL MODELING	9
Free space propagation model, Reflection- Diffraction — Scattering - Log-normal shadowing. Small-scale multipath propagation, Types of small-scale fading, Rayleigh and Ricean distribution, Input /output model of the wireless channel-Time and frequency coherence-Statistical channel models	
UNIT III ACCESS SCHEMES AND DIVERSITY	**9**
FDMA, TDMA, CDMA, SDMA and CSMA, OFDMA. Diversity Techniques—Frequency diversity, Time diversity, Code diversity, Antenna diversity–RAKE Receiver-SIMO, MISO, MIMO, MIMO-OFDM Technique	
UNIT IV CAPACITY OF WIRELESS CHANNELS	**9**
AWGN channel capacity — capacity of flat fading channels, Frequency-selective fading channels, Multiuser capacity, Downlink channel capacity, Uplink channel capacity, Outage capacity	
UNIT V EVOLUTION OF WIRELESS TECHNOLOGIES	**9**
Mobile Technologies - GSM, 3G, 4G (LTE) and 5G technologies, Wireless LAN Technologies and WLL.	
	Total Instructional hours: 45

Approved by BOS Chairman

Course Outcomes: Students will be able to	
CO1	Learn fundamentals of wireless communication.
CO2	Understand the concepts of channel modeling.
CO3	Study various access schemes in wireless communication.
CO4	Understand channel capacity in wireless networks.
CO5	Learn evolution of wireless technologies.

Text Books	
1.	Andrea Gold smith, " Wireless Communications", Cambridge University Press, 2012.
2.	DavidTse, Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2015.

Reference Books	
1.	Kamilo Feher,"Wireless Digital Communications, Modulation & Spread Spectrum Applications", PHI, 2015.
2.	William C.Y.Lee, "Mobile Communication Engineering", McGraw Hill, 2014.
3.	Theodore S.Rappaport, "Wireless Communications", Pearson Education,2017
4.	Andreas F.Molisch,"Wireless Communications", Wiley, 2011.
5.	Learn evolution of wireless technologies.

<table>
<tr><th colspan="5">Evaluation Pattern:</th></tr>
<tr><th colspan="4">Continuous Internal Assessment</th><th>End Semester Examinations</th></tr>
<tr><td colspan="2">CIA I (Theory)
(100 Marks)</td><td colspan="2">CIA II (Theory)
(100 Marks)</td><td rowspan="2">Theory End Semester Examinations
(Examinations will be conducted for 100 Marks)</td></tr>
<tr><td>* Alternate Assessment Tool (AAT)</td><td>Written Test</td><td>* Alternate Assessment Tool (AAT)</td><td>Written Test</td></tr>
<tr><td>40 Marks</td><td>60 Marks</td><td>40 Marks</td><td>60 Marks</td><td></td></tr>
<tr><td colspan="4">40 Marks</td><td>60 Marks</td></tr>
<tr><td colspan="5">Total: 100 Marks</td></tr>
</table>

- AAT - Individual Assignment/ Case Study/ Seminar/ Mini project/ MCQ/ Role Play/ Group Discussion/ Debates/ Oral Presentations/ Poster Presentations/ Technical Presentations can also be provided course coordinator can choose any one/two components based on the nature of the course.

Approved by BOS Chairman

B.E	B23EEO601 – GREEN ELECTRONICS AND SUSTAINABLE TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the fundamentals of Green Electronics.
2.	To explain sustainable materials and design practices.
3.	To reveal the renewable energy in Electronics.
4.	To understand the E-Waste management and recycling strategies.
5.	To explain the emerging trends in sustainable technologies.

UNIT-I	Introduction to Green Electronics	9
Overview of Green Electronics and Sustainability-Environmental Impact of Electronic Waste (E-Waste)- Energy Consumption in Electronics Manufacturing-Green Engineering Principles-Life Cycle Assessment (LCA) of Electronic Devices.		

UNIT-II	Sustainable Materials and Design	9
Eco-friendly and Biodegradable Electronic Materials-Sustainable Circuit Design Techniques-Low-power and Energy-efficient Semiconductor Technologies-Flexible and Organic Electronics-Sustainable PCB (Printed Circuit Board) Manufacturing.		

UNIT-III	Renewable Energy for Electronics	9
Solar Energy: Photovoltaics in Electronics-Energy Harvesting Techniques (Piezoelectric, Thermoelectric, etc.)- Battery Technologies and Green Energy Storage Solutions- Supercapacitors and Fuel Cells for Sustainable Electronics-Smart Grid and IoT for Energy Efficiency.		

UNIT-IV	Waste Management and Recycling of Electronics	9
E-Waste Recycling Techniques and Challenges-Circular Economy in Electronics-Regulations and Policies for Electronic Waste Management-Extended Producer Responsibility (EPR)- Case Studies on Successful E-Waste Management.		

UNIT-V	Emerging Trends and Future of Green Electronics	9
AI and IoT for Energy-efficient Systems-Sustainable Computing and Cloud Technologies-Green 5G and Communication Technologies-Carbon Footprint Reduction in Semiconductor Industries-Future Innovations in Sustainable Electronics.		
Total Instructional hours:45		

Approved by BoS Chairman

Course Outcomes: Students will be able to	
CO1	Illustrate the concept of green electronics and sustainability.
CO2	Explain the Sustainable Materials and Design with low-power and energy-efficient semiconductor technologies.
CO3	Demonstrate green energy storage solutions such as batteries, supercapacitors, and fuel cells.
CO4	Interpret the principles of e-waste recycling and the circular economy.
CO5	Infer the advancements in green computing, energy-efficient communication, and semiconductor technologies.

Text Books	
1.	John Lamb, “Green Electronics/Green Bottom Line: A Commonsense Guide to Environmentally Responsible Engineering and Management”, CRC Press, 2007.
2.	Santosh K. Kurinec, Krzysztof Iniewski, “Energy-Efficient Computing and Electronics: Devices to Systems”, CRC Press, 2019.
3.	Sunil Kumar, Vineet Kumar, “Electronic Waste Management: Policies, Processes, Technologies, and Impact”, Wiley Publications, 2023.
4.	Wayne C. W. Chan, Alan C. L. Wong, “Sustainable Electronics and Photonics”, Wiley publications, 2021.

Reference Books	
1.	Mohammad S. Obaidat, Alagan Anpalagan, Isaac Woungang, “Handbook of Green Information and Communication Systems”, Academic Press, 2013.
2.	Kaka Ma, “Sustainable Materials and Green Processing for Energy Conversion”, Trans Tech Publications, Elsevier, 2021
3.	Muhammad Zaffar Hashmi, Ajit Varma, “Environmental Impact of Electronic Waste and Sustainable Recycling Methods”, Springer, 2019.

Approved by BoS Chairman

B.E. / B.Tech	B23MEO601 - 3D PRINTING AND TOOLING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To explore the technology used in additive manufacturing.
2.	To develop CAD models for 3D printing.
3.	To acquire knowledge, techniques and skills to select relevant additive manufacturing process.
4.	To select a 3D printing process for an application.
5.	To produce a product using 3D Printing or Additive Manufacturing (AM).

UNIT - I	INTRODUCTION TO ADDITIVE MANUFACTURING (AM)	9

Overview – History – Need – classification - Additive Manufacturing Technology in product development – Materials for Additive Manufacturing.

UNIT - II	CAD AND REVERSE ENGINEERING	9

Basic concept – 3D scanning – digitization techniques – Model reconstruction – data processing for reverse engineering - Additive Manufacturing Technology : CAD model preparation – Part orientation and support generation – Model slicing – Tool path generation.

UNIT - III	LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING	9

Classification – liquid based system – stereo lithography apparatus (SLA) – principle, process, advantages and applications – solid based system – Fused Deposition Modeling – principle, process, advantages.

UNIT - IV	LASER BASED ADDITIVE MANUFACTURING SYSTEMS	9

Selective laser sintering – principles of SLS process – process, advantages and applications, 3D Printing - principle, process, advantages - Laser Engineered Net Shaping (LENS).

Approved by BoS Chairman

UNIT - V	RAPID TOOLING AND APPLICATIONS OF ADDITIVE MANUFACTURING	9
Principles and typical process for quick batch production of plastic and metal parts through quick tooling – applications for Aerospace, defence, automobile, Bio-medical and general engineering industries		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the importance of Additive Manufacturing.
CO2	Apply technique of CAD and reverse engineering for geometry transformation in Additive Manufacturing.
CO3	Define the various process used in Additive Manufacturing.
CO4	Identify and select suitable process used in Additive Manufacturing.
CO5	Understand the basic concept of quick tooling and additive manufacturing application.

Text Books	
1.	Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies : Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2.	Andreas Gebhardt, “Understanding Additive Manufacturing : Rapid Prototyping, Rapid Tooling, Rapid Manufacturing”, Hanser Publisher, 2011.
3.	Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi.

Reference Books	
1.	J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer Series in Material Science, 2013.
2.	Dougles Bryden, “CAD and Prototyping for Product Design”, 2014.
3.	CK Chua, Kah Fai Leong, “3D Printing and Rapid Prototyping- Principles and Applications”, World Scientific, 2017.

Approved by BoS Chairman

B.E / B.TECH	B23CBO601 DATA SCIENCE FOR BUSINESS ANALYTICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the basic concepts of Data Science.
2.	To understand the Analytics Life Cycle.
3.	To understand the process of acquiring Business Intelligence & various types of analytics for Business Forecasting
4.	To model the supply chain management for Analytics.
5.	To apply analytics for different functions of a business

UNIT- I Introduction to Data Science	9
Need for Data Science – Benefits and uses – Facets of data – Types of data- Organization of data - Data Science process- Data Science life cycle- Role of Data Science - Big Data – sources and characteristics of Big Data	

UNIT-II Introduction to Business Analytics	9
Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration	

UNIT- III Business Intelligence & Forecasting	9
Data Warehouses and Data Mart – Knowledge Management –Types of Decisions – Decision-Making Process – Decision Support Systems – Business Intelligence –OLAP – Analytic functions - Introduction to Business Forecasting and Predictive analytics – Logic and Data-Driven Models – Data Mining and Predictive Analysis Modeling –Machine Learning for Predictive analytics.	

Approved by BoS Chairman

UNIT- IV HR & Supply Chain Analytics	9
Human Resources – Planning and Recruitment – Training and Development – Supply chain network – Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain. Apply HR Analytics to make a prediction of the demand for hourly employees for a year.	

UNIT- V Marketing & Sales Analytics	9
Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales. Do predictive analytics for customers' behaviour in marketing and sales.	
Total Instructional hours: 45	

Course Outcomes: Students will be able to	
CO1	Understand the data science basics and its life cycle.
CO2	Understand the role of data science in business decision-making and strategy formulation.
CO3	Apply business intelligence tools and analytic functions.
CO4	Apply analytics in various HR functions such as recruitment, planning, and training.
CO5	Use predictive analytics to interpret and forecast customer behavior in marketing and sales contexts.

Text Books:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
2. Efrain Turban, Jay E.Aronson, Teng-Peng Liang, Ramesh Sharada "Decision Support Systems and Intelligent Systems" 8th Edition, Pearson Education, 2007.

Reference Books :

1. R. Evans James, Business Analytics, 2017.
2. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2017.
3. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2016.

Approved by BoS Chairman

MANDATORY COURSE I

B.E / B.Tech	B23MCT501- Environmental Sustainability (Common to ALL)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To understand ecosystems and the environment**,** including how they work and their importance.
2.	To learn about biodiversity and ways to protect endangered species.
3.	To Identify causes and solutions for pollution and waste management.
4.	To explore natural resources and how human activities affect them.
5.	To discuss global issues like climate change, population growth, and sustainable living.

SYLLABUS:

UNIT - I	ENVIRONMENT AND ECOSYSTEM	6
Scope and importance of environment - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers –energy flow in the ecosystem - food chains and food webs – structure and function of the (a) forest ecosystem (b) desert ecosystem (c) aquatic ecosystems (pond & marine).		

UNIT - II	BIODIVERSITY	6
Introduction to Biodiversity: Genetic, species and ecosystem diversity. Value of biodiversity - hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.		

UNIT - III	ENVIRONMENTAL POLLUTION	6
Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) soil pollution - solid waste management: causes, effects and control measures of municipal solid wastes.		

Approved by BoS Chairman

UNIT - IV	NATURAL RESOURCES	6
Forest resources: Use and over-exploitation, deforestation - Water resources: Use and over-utilization of surface and ground water - Land as a resource, land degradation, man induced landslides, soil erosion and desertification.		

UNIT - V	HUMAN POPULATION, SOCIAL ISSUES AND THE ENVIRONMENT	6
Population growth, variation among Nations – Population explosion. climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.		
	TOTAL INSTRUCTIONAL HOURS	30

Course Outcomes: Students will be able to	
CO1	Explain the structure and function of various ecosystems and explain the flow of energy through food chains and food webs.
CO2	Relate the types, values, and threats to biodiversity and differentiate between in-situ and ex-situ conservation methods.
CO3	Summarize the causes and impacts of major types of environmental pollution and suggest appropriate control measures.
CO4	Interpret the usage and over-exploitation of natural resources and analyse their environmental consequences.
CO5	Outline the impact of human population growth and social issues on environmental degradation and global climate phenomena.

Text Books	
1.	Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nedition,Pearson Education, 2004.
2.	Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006

Reference Books	
1.	G.Tyler Miller and Scott E. Spoolman, —'Environmental Science',Cengage LearningIndia Pvt, Ltd, Delhi, 2014
2.	Erach Bharucha, —Textbook of Environmental Studies‖, Universities Press (I) PVT, LTD, Hydrabad, 2015.

Approved by BoS Chairman

B.E / B.Tech	B23MCT502 - ELEMENTS OF LITERATURE (Common to ALL)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To understand and identify key literary elements in various texts.
2.	To analyze how authors use literary devices to convey themes and messages.
3.	To examine how character, setting, plot, and other elements contribute to the overall meaning of a work.
4.	To appreciate the different forms and genres of literature.
5.	To develop writing and analytical skills through discussions, essays, and presentations.

UNIT-I	INTRODUCTION TO LITERARY ELEMENTS	6

- **Overview of Literary Elements:** Definition and significance of literary elements
- **Introduction to the core components:** plot, setting, character, theme, and conflict
- Understanding literary genres (fiction, poetry, drama, nonfiction)

UNIT-II	PLOT AND STRUCTURE	6

- The five stages: Exposition, Rising Action, Climax, Falling Action, Resolution
- Types of conflict (man vs. man, man vs. self, man vs. nature, etc.)
- Plot devices (foreshadowing, flashbacks, etc.)

UNIT-III	CHARACTERIZATION	6

- **Types of Characters:** Protagonist, antagonist, dynamic, static, round, flat, etc. Direct vs. indirect characterization
- **Character Development:**
- How characters change or grow throughout a story
- Analyzing motivations, conflicts, and relationships

UNIT-IV	SETTING	6

- **Understanding Setting:**
- The time, place, and social environment of a story
- How setting influences plot and character development
- Symbolism and mood created through setting

Approved by BoS Chairman

UNIT-V	ANALYZING LITERARY WORKS	6
• **Close Reading and Analysis:** • Developing analytical skills through in-depth examination of texts • Understanding the role of diction, syntax, and tone in literature • **Comparative Analysis:** • Comparing works of literature across genres or time periods • Drawing connections between themes, characters, and literary devices		
		Total Instructional hours:30

Course Outcomes: Students will be able to	
CO1	Identify and Interpret Literary Elements. (K2)
CO2	Analyze Literary Devices. (K4)
CO3	Evaluate Narrative Structure. (K5)
CO4	Explore various literary forms and genres. (K3)
CO5	Develop Critical Thinking and Writing Skills. (K6)

Text Books	
1.	Narayan RK, “Malgudi Days”, Indian Thought Publications, New York, 2015
2.	Shaw, George Bernard, “Greatest works of George Bernard Shaw”, Maple Press, 2010
3.	Nair, Anita, “Ladies Coupe-A Novel in Parts”, Penguin Books, 2014

Reference Books	
1.	Abram, “A Glossary of Literary Terms”, Thomson India, 2008
2.	Trivedi, “India’s Shakespeare”, Pearson, 2008
3.	Orwell, George “Animal Farm”, Penguin Books Press, India, March 2011.
4.	Shakespeare, William “As You Like It”, Om Books International published, 2025.
5.	Allan Poe, Edgar, “The Raven”, Penguin Books Press, India, Oct 2013
6.	O. Henry, “The Gift Of The Magi”, Arcadia Publishing, December 2024

B.E / B.Tech	B23MCT503 - FOUNDATIONS OF YOGA	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To introduce the fundamental concepts and philosophy of Yoga and its relevance to modern life.
2.	To develop awareness of the physical, mental, and emotional benefits of Yoga through an understanding of its principles.
3.	To impart knowledge about the ethical and moral foundations of Yoga as described in Patanjali's Yoga Sutras (Yama, Niyama, etc.).
4.	To promote a healthy and disciplined lifestyle by integrating Yogic practices and values into daily routines.
5.	To enable students to manage stress and enhance concentration through the theoretical understanding of pranayama, meditation, and yogic relaxation techniques.

SYLLABUS:

UNIT - I	INTRODUCTION TO YOGA	6

- Definition, origin and evolution of Yoga.
- Aim, objectives, and relevance of Yoga in modern life.
- Different schools of Yoga (Raja Yoga, Karma Yoga, Bhakti Yoga, Jnana Yoga, Hatha Yoga).

UNIT - II	HEALTH AND YOGA	6

- Concept of health in Yoga.
- Holistic approach of Yoga to health and well-being.
- Role of Yoga in stress management.
- Yoga as preventive and therapeutic tool.

UNIT - III	YOGIC LIFESTYLE	6

- Yogic principles of food and diet.
- Importance of discipline (Yama, Niyama) in daily life.
- Daily routine and time management.
- Positive thinking and mental hygiene through Yoga.

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UNIT - IV	ASANAS	6

- Standing Asanas: Tadasana, Trikonasana, Vrikshasana.
- Sitting Asanas: Padmasana, Vajrasana, Ardha Matsyendrasana.
- Lying Asanas: Bhujangasana, Shalabhasana, Sarvangasana, Savasana.
- Benefits and precautions.

UNIT - V	MEDITATION AND RELAXATION	6

- Basics of Meditation.
- Guided Meditation Techniques.
- Yoga Nidra / Deep Relaxation Technique (DRT).
- Stress management through meditation.

TOTAL INSTRUCTIONAL HOURS	30

Course Outcomes: Students will be able to	
CO1	Illustrate the origin, definition, and philosophy of Yoga and its significance in holistic well-being.
CO2	Explain the principles and practices of Ashtanga Yoga as outlined by Patanjali.
CO3	Outline the role of Yoga in promoting physical health, mental clarity, and emotional stability.
CO4	Interpret the ethical and lifestyle principles of Yoga (Yama and Niyama) for personal development.
CO5	summarize how Yogic practices help in stress management and enhancing concentration in daily life.

Text Books	
1.	Light on Yoga – B.K.S. Iyengar. Publisher: HarperCollins,1966
2.	Patanjali Yoga Sutras – Swami Vivekananda commentary, Publisher: Advaita Ashrama, 1896.

Reference Books	
1.	Yoga for Health – Swami Kuvalayananda. *Publisher: Kaivalyadhama, Lonavala 1931.*
2.	Common Yoga Protocol – Ministry of AYUSH, Govt. of India, 2015

Approved by BoS Chairman

B.E /B.Tech	B25MCT504- EXPORT IMPORT MANAGEMENT (Common to ALL)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To learn the basics of international trade and its importance for businesses.
2.	To understand how goods are transported, paid for, and insured in global trade.
3.	To know how to choose the right products and markets for export.
4.	To get hands-on knowledge of export-import documents and procedures.
5.	To use digital tools and government support to grow your export business.

SYLLABUS:

UNIT - I	Introduction to Export and Import	6

Overview of International Trade, Importance of Export and Import in Business, International Trade Bodies and Local Regulatory Authorities, Export-Import Cycle: Step-by-Step Process, Online IEC (Import Export Code) Application, Myths and Opportunities in Global Trade.

UNIT - II	Logistics, Transportation & Payment Terms	6

Types of Transportation in International Trade, Containers, Packaging, and Shipment Handling, IncoTerms: Delivery Terms, Costs & Risks, Payment Terms: Modes of Payment & Risk Involved, Insurance and Risk Management in Trade.

UNIT - III	Product & Market Selection, Buyer Identification	6

Selecting the Right Product for Export, Market Research and Identifying Potential Markets, Importance of Trade Fairs & Exhibitions, Finding Genuine Buyers & Verification Process, Effective Communication with International Buyers.

UNIT - IV	Export & Import Documentation and Procedures	6

Understanding Proforma Invoice & Letter of Credit (LC), Pre & Post Shipment Documents, GST, Customs Clearance & Compliance Procedures, How to Fill Pre & Post Shipment Documents – Practical Exercise, Import Documentation and Procedures.

Approved by BoS Chairman

UNIT - V	Marketing, Incentives & Digital Trade Strategies	6
Export Incentives and Government Benefits, Pricing Strategies & Preparing Export Quotations, B2B Listing and Online Marketplaces, Digital Marketing & Social Media for Export Promotion, Buyer Calling, Data Collection & Product Portfolio Development.		

Course Outcomes: Students will be able to	
CO1	Explain the fundamentals of international trade, the role of trade bodies, and the complete export-import process. (K2)
CO2	Outline various transportation methods, Incoterms, packaging, payment terms, and risk management in international trade. (K2)
CO3	Apply knowledge to select suitable products and markets for export, identify genuine buyers, and effectively communicate in global trade. (K3)
CO4	Develop the ability to prepare and process export/import documentation, customs clearance, and GST compliance. (K3)
CO5	Utilize digital marketing, government incentives, and online platforms to develop export strategies and expand business opportunities. (K3)

Text Books	
1.	Thomas E. Johnson & Donna L. Bade, *Export/Import Procedures and Documentation*, 8th Edition, Ashgate Publishing, 2016.
2.	S. Tamer Cavusgil, Gary Knight, John R. Riesenberger, *International Business: The New Realities*, 3rd Edition, Pearson, 2017.
3.	P.K. Khurana, *Export-Import Theory, Practices, and Procedures*, 1st Edition, Atlantic Publishers & Distributors, 2016.
4.	Warren J. Keegan, Mark C. Green, *Global Marketing Management*, 9th Edition, Pearson, 2017.
5.	Francis Cherunilam, *International Trade and Export Management*, 9th Edition, Himalaya Publishing House, 2020

Approved by BoS Chairman

Reference Books	
1.	Anders Grath, *The Handbook of International Trade and Finance*, 3rd Edition, Kogan Page, 2020.
2.	Francis Cherunilam, *International Trade and Export Management*, 9th Edition, Himalaya Publishing House, 2020.
3.	V.K. Bhalla, *International Business: Theories and Practices*, 2nd Edition, Anmol Publications, 2020.
4.	S.K. Bhatia, *Export Management*, 1st Edition, Vikas Publishing House, 2018.
5.	R. Palaniappan, *International Trade and Export Management*, 1st Edition, Oxford University Press, 2019.

Approved by BoS Chairman

MANDATORY COURSE II

B.E / B.Tech	B23MCT601 – EDUCATION PSYCHOLOGY (Common to ALL)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To enable students to acquire knowledge about various methods of psychology.
2.	To gain knowledge about the concept of learning and its related theories.
3.	To understand motivation and its influence on human behaviour.
4.	To comprehend in-depth concepts of intelligence and creativity.
5.	To explain the concepts and theories of personality.

SYLLABUS:

UNIT - I	EDUCATIONAL PSYCHOLOGY AND HUMAN GROWTH AND DEVELOPMENT	6
Psychology: Meaning - Educational psychology: Meaning, scope and significance - Dimensions of human growth and development: Physical, cognitive, emotional, social, moral and language.		

UNIT - II	ATTENTION AND MEMORY	6
Attention: Meaning, nature and determinants of attention - Memory: Meaning, types of memory and Strategies for improving memory.		

UNIT - III	MOTIVATION AND LEARNING	6
Motivation: Meaning and definitions - Level of aspiration learning: Theories of learning and its educational implications Cognitive Theory: Jean Piajet, Behaviourist Theory- Pavlov's Classical, Conditioning.		

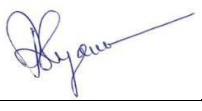
UNIT - IV	INTELLIGENCE AND CREATIVITY	6
Intelligence: Meaning, and types - Theories of Intelligence: Two factor, Thurston's Group factor - Intelligence Quotient (IQ) - Creativity: Concept, factors and process - Strategies for fostering creativity.		

UNIT - V	PERSONALITY	6
Personality: Meaning, definitions, and determinants of personality - Theories of Personality: Type, trait, and psychoanalytic Assessment of personality: Projective and non-projective techniques.		
TOTAL INSTRUCTIONAL HOURS		30

Course Outcomes: Students will be able to	
CO1	Explain various methods of psychology.
CO2	Describe the concept of learning and its related theories.
CO3	Discuss motivation and its influence on human behaviour.
CO4	Summarize the concepts of intelligence and creativity.
CO5	Interpret the concepts and theories of personality.

Text Books	
1.	Bert Laura, E. (2014). Child development. New Delhi: PHI Learning
2.	Chauhan, S. S. (2002). Advanced educational psychology. New Delhi: Vikas Publishing house.
3.	Hurlock, Elizabeth, B. (2015). Child development. New Delhi: McGraw Hill Education.
4.	Mangal, S.K. (2002). Advanced educational psychology. New Delhi: Prentice Hall of India.
5.	Matthews. G., Deary, L. J., & Whiteman, M.C. (2009). (2nd ed.). Personality: Theory and research. New York: Guilford Publications.

Reference Books	
1.	AnithaWoolfolk. (2004). Educational psychology. Singapore: Pearson Education.
2.	Cloninger, S.C. (2008) (5thed.). Theories of personality: Understanding persons. Englewood Cliffs, New Jersey: Prentice Hall.
3.	Schunk, D.H. (2007) (5thed.). Learning theories: An educational perspective. New York: Prentice Hall of India.
4.	Skinner, C.E. (2003) (4thed.). Educational psychology. New Delhi: Prentice Hall of India.
5.	Sprint Hall Norman, A, & Sprint Hall, Richard, C. (1990) (5thed.). Educational psychology: A developmental approach. New Delhi: McGraw Hill.



Approved by BoS Chairman

B.E / B.Tech	B23MCT602- Life Style Education (Common to ALL)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To understand the importance of a healthy lifestyle and its impact on overall well-being.
2.	To learn about balanced nutrition, the role of essential nutrients, and healthy eating habits.
3.	To explore the benefits of regular exercise and different types of physical activities.
4.	To identify common lifestyle diseases and strategies for their prevention.
5.	To develop mental wellness through stress management, mindfulness, and better sleep habits.

UNIT - I	Introduction to a Healthy Lifestyle	6

- Definition & importance of a healthy lifestyle
- Nutrition, exercise, sleep, and mental well-being.
- Assessing current lifestyle habits.

UNIT - II	Nutrition & Balanced Diet	6

- Macronutrients & micronutrients: Their roles and sources.
- Healthy eating habits and meal planning.
- Importance of hydration.
- Harmful effects of processed food and unhealthy eating habits.

UNIT - III	Physical Fitness & Exercise	6

- Benefits of regular exercise on physical and mental health.
- Types of workouts: Cardio, strength training, yoga, and flexibility exercises.
- Designing a personalized fitness routine.

UNIT - IV	Lifestyle Diseases & Prevention	6

- Causes and prevention of obesity, diabetes, heart disease, and hypertension.
- Role of diet, exercise, and mental health in disease prevention.
- Importance of regular health check-ups.

UNIT - V	Mental Health & Stress Management	6

- Understanding stress, anxiety, and depression.
- Techniques for relaxation: Meditation, deep breathing, and mindfulness.
- Importance of sleep for overall health.
- Tips for improving sleep hygiene.

TOTAL INSTRUCTIONAL HOURS	30

Course Outcomes: Students will be able to	
CO1	Explain the importance of a healthy lifestyle and its key aspects like nutrition, exercise, sleep, and mental well-being.
CO2	Describe the role of nutrients, healthy eating habits, and the effects of processed food.
CO3	Summarize different types of exercises and their benefits for physical and mental health.
CO4	Identify common lifestyle diseases, their causes, and ways to prevent them.
CO5	Discuss stress, anxiety, and sleep issues, along with techniques to manage them.

Text Books	
1.	*Francesc García, Héctor,Miralles*, Ikigai: The Japanese Secret to a Long and Happy Life, Penguin Audio, 2017.
2.	Relationship, wellbeing and behaviour, Harry T. Reis, World Library of Psychological series, Reutledge, Taylor and Francis Group, 2018.

Reference Books	
1.	Shawn Achor, The Happiness Advantage: How a Positive Brain Fuels Success in Work and Life, Crown Currency, 2018.
2.	James Clear, Atomic Habits: An Easy & Proven Way to Build Good Habits & Break Bad Ones, Penguin Audio, 2018.

Approved by BoS Chairman

B.E / B.Tech	B25MCT603 STARTUP AND VENTURE FUNDING (Common to ALL)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To understand new venture creation opportunities, its resources, and requirements for Enterprise Start-up
2.	To understand the legal environment.
3.	To learn about the start-up environment and survival.
4.	To study the various funding availabilities for startups.
5.	To analyse the venture capital funding and its stages.

UNIT - I	Start-up An Overview	6

Introduction to start ups - The rise of startup economy – Ideation- Venture Choices - The Start-up Equation – The Entrepreneurial Ecosystem – Entrepreneurship in India. Government Initiatives.

UNIT - II	Start-up Capital Requirements and Legal Environment	6

Identifying startup capital requirements - estimating startup cash requirements - Startup financing metrics – Risk mitigation strategies - The legal framework for startups - Incorporation and commencement of businesses and registration of a company.

UNIT - III	Start-up Survival and Growth	6

Feasibility Study - Stages of growth of start-ups – Reasons for new start up failures- Scaling new ventures – preparing for change - Leadership succession. Support for growth and sustainability of the venture.

UNIT - IV	Funding of Start Up Ventures	6

Financing Opportunities for startups – Equity investment process – Angel Investors - Funding startups with bootstrapping- crowd funding- strategic alliances.

UNIT - V	Venture Capital Funding	6
Venture Capital – Meaning and features – Seed capital – Financing various stages of startup ventures – Exit strategy for venture capital funds.		

Course Outcomes: Students will be able to	
CO1	Implement entrepreneurship concepts in a start-up idea. (K3)
CO2	Use budgeting and legal setup processes for the venture. (K3)
CO3	Demonstrate feasibility through market and financial analysis. (K3)
CO4	Execute funding strategies suited for a new business. (K3)
CO5	Apply suitable funding methods for different stages of a new business using basic financial models and strategies. (K3)

Text Books	
1.	Kathleen R Allen, Launching NewVentures, An Entrepreneurial Approach, Cengage Learning, 2016.
2.	AnjanRaichaudhuri, Managing New Ventures Concepts and Cases, Prentice Hall International, 2010.
3.	S. R. Bhowmik& M. Bhowmik, Entrepreneurship, New Age International, 2007.

Reference Books	
1.	Steven Fisher, Ja-nae' Duane, The Startup Equation -A Visual Guidebook for Building Your Startup, Indian Edition, Mc Graw Hill Education India Pvt. Ltd, 2016.
2.	Donald F Kuratko, Jeffrey S. Hornsby, New Venture Management: The Entrepreneur's Road Map, 2e, Routledge, 2017.
3.	Vijay Sathe, Corporate Entrepreneurship, 1e, Cambridge, 2009.

Approved by BoS Chairman

B.E / B.Tech	B23MCT604 – INDIAN KNOWLEDGE SYSTEM	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To introduce the scope and significance of Indian Knowledge Systems in the context of modern education and engineering.
2.	To explore ancient Indian contributions in science, mathematics, technology, and architecture.
3.	To understand core Indian philosophies, ethics, and values and their relevance in personal and professional life.
4.	To connect traditional practices with modern innovations through case studies and project-based learning.
5.	To promote sustainable thinking and design approaches inspired by indigenous knowledge and practices.

SYLLABUS:

UNIT - I	INTRODUCTION TO INDIAN KNOWLEDGE SYSTEM	6

- Meaning and scope of IKS
- Importance of IKS in modern education
- Relevance of IKS to science, technology, and engineering.

UNIT - II	SCIENCE AND TECHNOLOGY IN ANCIENT INDIA	6

- Contributions in mathematics (e.g., zero, decimal system, algebra – Aryabhata, Bhaskara)
- Ancient metallurgy (e.g., Iron Pillar of Delhi, zinc extraction)
- Astronomy and calendar systems (e.g., Surya Siddhanta, Jantar Mantar)
- Ayurveda and traditional health sciences.

UNIT - III	ENGINEERING AND ARCHITECTURE	6

- Vastu Shastra and ancient Indian architecture
- Temple construction and civil engineering marvels
- Water management systems (step wells, tanks, canals)
- Town planning in Harappan civilization.

Approved by BoS Chairman

UNIT - IV	INDIAN PHILOSOPHY, ETHICS & VALUE SYSTEM	6

- Core concepts of Indian philosophy (Dharma, Karma, Yoga)
- Ethical principles in Indian tradition
- Role of values in professional and personal life
- Indian view on environmental sustainability.

UNIT - V	ARTS, CULTURE, AND LITERATURE	6

- Overview of Indian classical music and dance
- Ancient literature (Vedas, Upanishads, Ramayana, Mahabharata)
- Sanskrit and its scientific relevance
- Cultural practices and their scientific background.

	TOTAL INSTRUCTIONAL HOURS	30

Course Outcomes: Students will be able to	
CO1	Explain the meaning, scope, and importance of Indian Knowledge Systems in the context of modern education.
CO2	Outline the key scientific and technological advancements of ancient India in fields like mathematics, metallurgy, and astronomy.
CO3	Interpret traditional Indian architectural and engineering practices, including Vastu Shastra and water management systems.
CO4	Illustrate the ethical values and philosophical principles of Indian traditions and their relevance in contemporary life.
CO5	Summarize the applications of IKS in modern innovation, entrepreneurship, and sustainable engineering practices.

Text Books	
1.	Introduction to Indian Knowledge Systems: Concepts and Applications, B. Mahadevan, Publisher: PHI Learning Pvt. Ltd. 2016.
2.	Science and Technology in Ancient India,: Roshen Dalal,Publisher: Penguin Books.2003
3.	Foundations of Indian Culture, Govind Sadashiv Ghurye, Publisher: Popular Prakashan. 1951

Reference Books	
1.	Indian Knowledge Systems – Volume 1, Kapil Kapoor & Michel Danino Publisher: Central Sanskrit University & Bharatiya Vidya Bhavan, 2021.
2.	The Argumentative Indian, By: Amartya Sen, Publisher: Picador, 2005.

Approved by BoS Chairman