KLE Technological University | Creating Value, Leveraging Knowledge

Curriculum Structure and Curriculum Content for the Academic Batch – 2021-25
School / Department : Biomedical Engineering
Program: Bachelor of Engineering

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Vision and Mission of KLE Technological University

Vision

KLE Technological University will be a national leader in Higher Education–recognized globally for innovative culture, outstanding student experience, research excellence and social impact.

Mission

KLE Technological University is dedicated to teaching that meets highest standards of excellence, generation and application of new knowledge through research and creative endeavors.

The three-fold mission of the University is:

- To offer under graduate and post-graduate programs with engaged and experiential learning environment enriched by high quality instruction that prepares students to succeed in their lives and professional careers.

- To enable and grow disciplinary and inter-disciplinary areas of research that build on present strengths and future opportunities aligning with areas of national strategic importance and priority.

- To actively engage in the Socio-economic development of the region by contributing our expertise, experience and leadership, to enhance competitiveness and quality of life.

As a unified community of faculty, staff and students, we work together with the spirit of collaboration and partnership to accomplish our mission.

Vision and Mission Statements of the School / Department

Vision

KLE Tech-Department of Biomedical Engineering will be well recognized nationally and internationally for excellence in its educational programs, pioneering research and impact on the industry and society.

Mission

1. To achieve academic excellence by applying biomedical engineering knowledge.
2. To adapt emerging technologies in biomedical engineering through continual learning.
3. To acquire the knowledge of medical instrumentation through engineering and related R & D activities.
4. To work with hospitals and healthcare industries to enhance practical knowledge.
5. To develop competencies for employability and entrepreneurship in core and Interdisciplinary areas.

Program Educational Objectives/Program Outcomes and Program-Specific Objectives

Program Educational Objectives-PEO's
1. Apply the engineering concepts to maintain biomedical equipment's and develop Medical software.
2. Exhibit technical competence by upgrading their knowledge in Biomedical Engineering.
3. Inculcate the sense of social responsibility and practice ethics to work with varied groups.
Program Outcomes - PO's
PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/Development of Solutions: 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 public health and safety, and cultural, societal, and Environmental considerations.
PO4: 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.
PO5: 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.
PO6 :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.
PO7: 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.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms Of the engineering practice.
PO9: Individual and teamwork: 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 the 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.
PO11: 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.
PO12: 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 Objectives-PSO's
PSO1: Acquire proficiency in the field of medical instrumentation, signal & image processing and hospital management.
PSO2: Attain employability in Biomedical engineering and associated fields.
PSO3: Exhibit professional communication and team building skills through seminars, projects, workshops, hospital survey and internships.

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Curriculum Structure-Overall

	I	II	III	IV	V	VI	VII	VIII
	Single Variable Calculus (4-1-0)	Multivariable Calculus (4-1-0)	Corporate Communication (0.5-0-0)	Problem Solving & Analysis (0.5-0-0)	Arithmetical Thinking & Analytical Reasoning (0.5-0-0)*Audit	Industry Readiness & Leadership Skills (0.5-0-0)*Audit	Medical Imaging Systems (4-0-0)	Elective 6 /Internship (3-0-0)
	Engineering Physics (3-0-0)	Engineering Chemistry (3-0-0)	Integral Transforms And Statistics (4-0-0)	Linear Algebra & Partial Differential Equations (4-0-0)	Fundamental of Signals and DSP (4-0-0)	Medical Image Processing (3-0-0)		
	Engineering Mechanics (4-0-0)	Problem Solving with Data Structures (0-0-3)	Circuits Analysis (4-0-0)	Signal Conditioning and Data Acquisition Circuits (4-0-0)	Clinical Instrumentation (4-0-0)	Biomedical DSP (3-0-0)		
	C Programming for Problem Solving (0-0-3)	Engineering Exploration (0-0-3)	Analog Electronic Circuits (4-0-0)	Biomedical Instrumentation (4-0-0)	Therapeutic Devices (4-0-0)	PSE Elective 1 (3-0-0)	Elective 2 – 15EECE	
	Basic Electrical Engineering (3-0-0)	Basic Electronics (4-0-0)	Digital Circuits (4-0-0)	Human Anatomy and Physiology (4-0-0)	Operating System & Embedded System Design (3-0-0)	Biomedical DSP Lab (0-0-1)	Elective 3 – 15EECE	
	Social Innovation (0-1-1)	Basic Mechanical Engineering (2-1-0)	Electronic Instrumentation & Measurements (4-0-0)	ARM Processor & Applications (3-0-0)	MLDL (2-0-2)	Medical Image Processing Lab (0-0-1)	Elective 4 – 15EECE Elective 5 – 15EECE (3-0-0) Elective GEN AI (2-0-1)	

Course with Course Code

	Engineering Physics Lab (0-0-1)	Professional Communication (1-1-0)	Digital Circuits Lab (0-0-1)	Signal Conditioning and Data Acquisition Lab (0-0-2)	Clinical Instrumentation Lab (0-0-1)	GEN AI (2-0-1)		Open Elective 1 – Internship (3-0-0)
			Analog Electronic Circuits Lab (0-0-1)	Biomedical Instrumentation Lab (0-0-1)	Real Time Operating systems Lab (0-0-1)	Minor Project-II (0-0-6)		Project Work (0-0-11)
			Microcontroller Architecture & Programming (2-0-1)	ARM Microcontroller Lab (0-0-1)	Mini Project (0-0-3)	PALR (0-0-0)*Audit	Senior Design Project (0-0-6)	
			C Programming (Dip) (0-0-2)	Data Structure using C Lab (Dip) (1-0-2)			CIPE (2-0-0)	
			Calculus and Integral Transforms (Dip) (4-0-0)	Vector Calculus Differential Equations (Dip) (4-0-0)				
Credits	**21**	**23**	**25.5**	**24.5**	**23.5**	**20.5**	**24**	**17**

Curriculum Structure-Semester wise

Semester-1

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in hrs.)
1	18EMAB101	Single Variable Calculus	BS	4-1-0	5	6	50	50	100	3hrs
2	15EPHB101	Engineering Physics	BS	3-0-0	3	3	50	50	100	3hrs
3	15ECVF101	Engineering Mechanics	ES	4-0-0	4	4	50	50	100	3hrs
4	18ECSP101	C Programming for Problem solving	ES	0-0-3	3	6	80	20	100	3hrs
5	18EEEF101	Basic Electrical Engineering	ES	3-0-0	3	3	50	50	100	3hrs
6	15EHSP101	Social Innovation	HSS	0-1-1	2	3	50	50	100	1.5hrs
7	16EPHP101	Engineering Physics Lab	BS	0-0-1	1	2	80	20	100	3hrs
Total				**14-2- 5**	**21**	**27**	**410**	**290**	**700**	

Semester-2

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in hrs.)
1	18EMAB102	Multivariable Calculus	BS	4-1-0	5	6	50	50	100	3hrs
2	15ECHB102	Engineering Chemistry	BS	3-0-0	3	3	50	50	100	3hrs
3	18ECSP102	Problem Solving with Data Structures	ES	0-0-3	3	6	80	20	100	3hrs
4	15ECRP101	Engineering Exploration	ES	0-0-3	3	6	80	20	100	3hrs
5	18EECF101	Basic Electronics	ES	4-0-0	4	4	50	50	100	3hrs
6	15EMEF101	Basic Mechanical Engineering	ES	2-1-0	3	4	50	50	100	3hrs
7	15EHSH101	Professional Communication	HSS	1-1-0	2	3	50	50	100	1.5hrs
Total				**15-2-6**	**23**	**32**	**410**	**290**	**700**	

Semester-3

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in hrs.)
1	15EMAB203	Integral Transforms and Statistics	BS	4-0-0	4	4	50	50	100	3 hours
2	22EBMC201	Circuit Analysis	PC	4-0-0	4	4	50	50	100	3 hours
3	22EBMC 202	Analog Electronic Circuits	PC	4-0-0	4	4	50	50	100	3 hours
4	19EECC201	Digital Circuits	PC	4-0-0	4	4	50	50	100	3 hours
5	22EBMC 203	Electronic Instrumentation & Measurements	ES	4-0-0	4	4	50	50	100	2 hours
6	22EBMP201	Digital Circuits Lab	PC	0-0-1	1	2	80	20	100	2 hours
7	22EBMP202	Analog Electronic Circuits Lab	PC	0-0-1	1	2	80	20	100	2 hours
9	22EBMF202	Microcontroller Architecture & Programming	ES	2-0-1	3	6	80	20	100	2 hours
10	22EBMF204	C Programming (Dip)	ES	0-0-2	2	4	80	20	100	2 hours
11	22EHSC201	Corporate Communication	--	0.5-0-0	0.5	1	100	--	100	3hours
12	15EMAB232	Calculate & Integral Transforms	BS	4-0-0	4	4	50	50	100	3hours
TOTAL				**22-0-3**	**25.5**	**28**	**490**	**310**	**800**	

Semester-4

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in hrs.)
1.	15EMAB208	Linear Algebra & Partial Differential Equations	BS	4-0-0	4	4	50	50	100	3 hours
2.	22EBMC204	Signal Conditioning and Data acquisition	PC	4-0-0	4	4	50	50	100	3 hours
3.	22EBMC205	Biomedical Instrumentation	PC	4-0-0	4	4	50	50	100	3 hours
4.	22EBMC206	Human Anatomy Physiology	PC	4-0-0	4	4	50	50	100	3 hours
5.	22EBMC207	ARM Processor & Applications	PC	3-0-0	3	3	50	50	100	3 hours
6.	22EBMP203	Biomedical Instrumentation Lab	PC	0-0-2	2	4	80	20	100	2 hours
7.	22EBMP204	ARM Controller Lab	Pc	0-0-1	1	3	80	20	100	2 hours
8.	22EBMP205	Signal Conditioning and Data Acquision Lab	PC	0-0-2	2	4	80	20	100	2 hours
9.	22EBMF205	D Data Structure Using C – Lab (Dip)	PC	0-0-2	2	5	80	20	100	2 hours
10.	15EMAB242	D Vector Calculus Differential Equation	BS	4-0-0	4	4	50	50	100	3 hours
11.	22EHSH202	Pro Problem solving and Analysis	…	0.5-0-0	0.5	4	100	…	100	3 hours
	Total			**18-0-6**	**24.5**	**29**	**720**	**380**	**1100**	

Semester-5

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in hrs.)
1.	22EBMC301	Fundamentals of Signals and DSP	PC	4-0-0	4	4	50	50	100	3 hours
2.	22EBMC302	Clinical Instrumentation	PC	4-0-0	4	4	50	50	100	3 hours
3.	22EBMC303	Therapeutic Devices	PC	4-0-0	4	4	50	50	100	3 hours
4.	22EBMC304	Operating System & Embedded Systems Design	PC	3-0-0	3	3	50	50	100	3 hours
5.	23EBMW301	Mini Project	PW	0-0-3	3	6	50	50	100	2 hours
6.	22EBMP301	Clinical Instrumentation Lab	PC	0-0-2	2	4	80	20	100	3 hours
7.	22EBMP302	Real Time Operating Systems Lab	PC	0-0-1	1	2	80	20	100	2 hours
8.	22EHSH301	Arithmetical Thinking & Analytical Reasoning		0.5-0-0	0.5	1	100	…	100	3 hours
TOTAL				**15.5-0-6**	**21.5**	**28**	**510**	**290**	**800**	

Semester-VI

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in hrs.)
1.	16EHSC301	Professional Aptitude and Logical reasoning.	HC	3-0-0	Audit	3	50	50	100	3 hours
2.	22EHSH302	Industry Readiness & Leadership Skills	ES	0.5-0-0	Audit	1	100	--	100	3 hours
3.	22EBMC305	Medical Image Processing	PC	3-0-0	3	3	50	50	100	3 hours
4.	22EBMC206	Biomedical DSP	PC	3-0-0	3	3	50	50	100	3 hours
5.	22EBME31X	Professional Elective -01	PE	3-0-0	3	3	50	50	100	3 hours
6.	22EBMP303	Biomedical DSP Lab	PC	0-0-1	1	2	80	20	100	2 hours
7.	22EBMP304	Medical Imaging Processing Lab	PC	0-0-1	1	2	80	20	100	2 hours
8.	22EBMF301	Machine Learning	PC	2-0-1	3	4	100		100	2 hours
9.	22EBMW302	Minor Project I	PW	1-0-4	5	9	50	50	100	2 hours
10.	22EBMW303	Minor Project – II	PW	0-0-5	5	10	50	50	100	2 hours
TOTAL				**15.5-0-12**	**24**	**40**	**640**	**360**	**1000**	

Semester-VII

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration
1	22EBMC401	Medical Imaging Systems	PSC	4-0-0	4	4	50	50	100	3hours
2	22EBME41X	Elective 2	PSE	3-0-0	3	3	50	50	100	3hours
3	22EBME42X	Elective 3	PSE	3-0-0	3	3	50	50	100	3hours
4	22EBME43X	Elective 4	PSE	3-0-0	3	3	50	50	100	3hours
5	20EECW401	Senior Design Project	PW	0-0-6	6	12	50	50	100	3hours
6	15EHSC402	CIPE	M	2-0-0	2	2	50	50	100	3hours
TOTAL				**15-0-6**	**21**	**27**	**350**	**350**	**700**	

Semester-VIII

No	Code	Course	Category	L-T-P	Internship	Credits	Contact Hours	ISA	ESA	Total	Exam Duration
1	22EBME46X	PSE Elective 5	PSE	6-0-0	6-0-0	3	3	50	50	100	3hours
2	22EBMO4XX	Open Elective 1	OE	3-0-0		3	3	50	50	100	3hours
3	22EBMW402	Capstone Project Work	PRJ	0-0-11		11	22	50	50	100	3hours
				6-0-11		17	28	150	150	300	

Semester	I	II	III	IV	V	VI	VII	VIII	**Total**
Credits	21	23	25.5	24.5	21.5	24	21	17	177.5

List of Open Electives

Sr. No	Name of the Course	Course Code
1.	Bio Signal Processing	22EBMO401
2.	Virtual Instrumentation	22EBMO402
3	Image Processing	22EBMO403
4.	Medical Physics	22EBMO404

List of Program Electives

Sr. No	Name of the Course	Course Code
1.	Java Programming	22EBME311
2.	Automotive Electronics	22EBME312
3.	OOP's using C++	22EBME313
4.	Python	22EBME314
5.	Hospital Design, Planning Management	22EBME321
6.	Medical Device Regulations and Safety	22EBME322
7.	Biological Control systems	22EBME323
8.	Scientific and Analytical Instrumentation	22EBME324
9.	Data Base Management in Healthcarer	22EBME441
10.	Bio – MEMS	22EBME442
11.	Rehabilitation Engineering	22EBME443
12.	Lasers and Optical Fibers in Medicine	22EBME444
13.	Artificial Organs and Assistive Devices	22EBME461
14.	Computer Communication in Health Care Networking	22EBME462
15.	Medical Informatics and Expert systems	22EBME463
16.	Biomechanics	22EBME464

Curriculum Content – Course wise

Program: Biomedical Engineering		**Semester: I**
Course Title: Single Variable Calculus		**Course Code: 18EMAB101**
L-T-P: 4-1-0	**Credits:5**	**Contact Hours: 6hrs/week**
ISA Marks: 50	**ESA Marks:50**	**TotalMarks:100**
Teaching Hours:50Hrs	**ExaminationDuration:3 Hrs.**	

Unit I

1. Functions, Graphs and Models(07 hours)

Functions, types of functions, transformations and models (Linear, exponential, trigonometric). MATLAB: Graphing functions, Domain-Range and Interpreting the models

2. Calculus of functions and models(13hours)

Limit of a function, Infinite limits- graph, Continuity and discontinuity, Intermediate value theorem statement, Roots of the equation using Bisection Method and Newton- Raphson Method Interpretation of derivative asarate of change, All the rules of derivatives (Listonly), Maxima, Minima and optimization problems. Curvature and Radius of Curvature, Indeterminate forms, L- Hospital's rule-Examples

MATLAB: optimization problems. Curvature problems

Unit II

3. Infinite Series(06hours)

Definition, Convergence of series, Tests of convergence – p-series, Alternating series. Power series, radius of convergence, Taylor's and Maclaurin's series, Applications of Taylor's and Maclaurin's series

MATLAB: Convergence of series

4. Integral calculus (14hours)

Tracing of standard curves in Cartesian form, Parametric form and Polar form; Beta and gamma function, relation between them, evaluation of integrals using Beta and gamma functions; Application stofindarc length, Area, Volume and surface area (Cartesian, parametric and polar curves). Approximate integration-Trapezoidal rule, Simpson's 1/3 rule

MATLAB: problem sonarclength, area, volume and surface area

Unit III

5. Ordinary differential equations of first order (10hours)

(a) Introduction to Initial Value problems. Linear and Bernoulli's equations, Exact equations and reducible to exact form, Numerical solution to Initial Value problems-Euler's method,

Modified Euler's method and Runge – Kutta method

(b) Applications of first order differential equations-Orthogonal trajectories growth and decay problems, mixture problems, Electrical circuits, falling bodies.

MATLAB: Solve differential equations

Text Books:

1. Early Transcendental Calculus-James Stewart, Thoms on Books, 7ed2010.

Reference Books:

1. CalculusSingleandMultivariable, Hughues-HallettGleason,WileyIndiaEd, 4ed, 2009.
2. ThomasCalculus,GeorgeBThomas,PearsonIndia,12ed,2010

Back to Semester I

Program: Biomedical Engineering		**Semester: I**
Course Title: Engineering Physics		**Course Code: 15EPHB101**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3hrs/week**
ISA Marks: 50	**ESA Marks:50**	**Total Marks: 100**
Teaching Hours: 40Hrs	**Examination Duration: 3 Hrs**	

Unit I

Chapter 1: Conduction in semiconductors(05hours)

Atomic theory: The atom, electron or bits and energy levels, energy bands, Conduction in solids: Electron motion and hole transfer, conventional current and electron flow Conductors, semiconductors and insulators: Bonding force between atoms, Energy bands in different materials. N-type and p-type Semiconductors: Doping, n-Type material, p-Type material, Majority and minority charge carriers, Effects of heat and light, charge carrier density. Semiconductor conductivity: Drift current, diffusion current, charge carrier velocity, conductivity, Hall Effect.

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Chapter2: Junctions (10hours)

The pn - Junctions: Junction of p-Type and n-Type, Barrier voltage, depletion region, Qualitative theory of p-n Junction. Biased junctions: Reverse biased unction, forward biased junction, junction temperature effects. Junction currents and voltages: Shockley equation, junction currents, junction voltages. P-n Junction Diode characteristics and parameters: Forward and reverse characteristics, diode parameters. Diode approximations: Ideal diode and practical diodes, piecewise linear characteristics, DC equivalent circuits. DC load line analysis: DC load line, Q-Point, calculating load resistance and supply voltage. Temperature Effects: Diode power dissipation, forward voltage drop, dynamic resistance. Diode AC models: Junction capacitance, AC-equivalent circuits (Reverse biased and forward biased), reverse recovery time. Diode specifications: Diode data sheets, low power diodes, rectifier diodes. Diode testing: Ohm meter tests, use of digital meter, plotting diode characteristics. Zener diodes: Junction breakdown, circuit symbols and packages, characteristics and parameters, data sheet, equivalent circuits.

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Unit II

Chapter3: Electrostatics (15hours)

Review on vectors: Coordinate Systems, Vector and Scalar Quantities, Properties of Vectors, Components of a Vector and Unit Vectors

(Text2PageNo59-77) Electric

Fields:

Properties of Electric Charges, Charging Objects by Induction, Coulomb's Law, Analysis Model: Particle in a Field (Electric), Electric Field of a Continuous Charge Distribution, Electric Field Lines Motion of a Charged Particle in a Uniform Electric Field

Gauss's Law:
Electric Flux, Gauss's Law, Application of Gauss's Law to Various Charge Distributions, Conductors in Electrostatic Equilibrium

Electric Potential:
Electric Potential and Potential Difference, Potential Difference in a Uniform Electric Field, Electric Potential and Potential Energy Due to Point Charges, Obtaining the Value of the Electric Field from the Electric Potential, Electric Potential Due to Continuous Charge Distributions Electric Potential Due to a Charged Conductor, Applications of Electrostatics

Capacitance and Dielectrics:
Definition of Capacitance, Calculating Capacitance, Combinations of Capacitors, Energy Stored in a Charged Capacitor, Capacitors with Dielectrics, Electric Dipole in an Electric Field, An Atomic Description of Dielectrics

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Unit III
Chapter4: Electro magnetics (10hours)

Magnetic Fields:
Analysis Model: Particle in a Field (Magnetic), Motion of a Charged Particle in a Uniform Magnetic Field, Applications Involving Charged Particles Moving in a Magnetic Field, Magnetic Force Acting on a Current-Carrying Conductor, Torque on a Current Loop in a Uniform Magnetic Field,

Sources of the Magnetic Field: The Biot – Savart Law, The Magnetic Force Between Two Parallel Conductors, Ampere's Law, The Magnetic Field of a Solenoid, Gauss's Law in Magnetism, Magnetism in Matter

Faraday's Law: Faraday'sLawofInduction,Motionalemf,Lenz'sLaw,InducedemfandElectric Fields Generators and Motors, Eddy Currents

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Text Book:

1. David A Bell, "Electronics Devices and Circuits", Fifth Edition, Oxford University Press.
2. Serway and Jewett, "Physics for Scientists and Engineers – with Modern Physics", 9th Edition, CENGAGE learning. 2014

Reference Books:

1. Jacob Millman and Christos Halkias, "Electronic Devices and Circuits" TMH
2. R P Feynman, Robert B Leighton, Matthew Sands, The Feynman Lectures on Physics Vol-II, Norosa Publishing House (1998).
3. BenGStreetman,SolidStateElectronicDevices,PrenticeHall,1995

Back to Semester I

Program: Biomedical Engineering		**Semester: I**
Course Title: Engineering Mechanics		**Course Code: 15ECVF101**
L-T-P: 4-0-0	**Credits:4**	**Contact Hours: 4hrs/week**
ISA Marks: 50	**ESA Marks:50**	**Total Marks: 100**
Teaching Hours: 50Hrs	**Examination Duration:3 Hrs**	

Unit I

Chapter 1: Over view of Civil Engineering (04hours)

Evolution of Civil Engineering Evolution of Civil Engineering Specialization, scope and role. Impact of Civil Engineering on National economy, environment and social & cultural fabric. Challenges and Opportunities for Civil Engineers Civil Engineering Marvels, Future challenges, Higher education and Research.

Chapter 2: Coplanar concurrent force system (12hours)

Introduction to Engineering Mechanics: Basic idealizations – Particle, Continuum, Body, Rigid body, Deformable body, Definition of force and its elements; Laws of Mechanics – Parallelogram law of forces, Principle of transmissibility, Law of Superposition, Newton's laws of motion. Classification of force systems Resultant of coplanar concurrent force system: Definitions – Resultant, composition & Resolution of a force, Equilibrium, Equilibrant, Formulae for resultant of forces and resolution of a force. Numerical problems on resultant of forces. Equilibrium of coplanar concurrent force system: Conditions of equilibrium, Action & Reaction, Free body diagram, Lamis' theorem. Numerical problems on equilibrium of forces.

Chapter 3: Coplanar non-concurrent force system (05hours)

Resultant of a force system: Moment, moment of a force, couple, moment of a couple, Characteristics of couple, Equivalent force-couple system, Numerical problems on moment of forces and couples, on equivalent force-couple system. Varignons principle of moments, Resultant of coplanar- non-concurrent force systems and numerical problems.

Unit II

Chapter 4: Equilibrium of a force system (Chapter 3 contd...) (05hours)

Conditions of equilibrium, types of support and loading for a statically determinate beam, Reactions at support connections, Numerical problems on equilibrium of force systems and support reactions for a statically determinate beam.

Chapter 5: Static Friction (08hours)

Introduction, types of friction, definition, limiting friction, coefficient of friction, laws of Coulomb friction, angle of friction and angle of repose, cone of friction. Wedge and belt friction theory. Derivation of belt friction formula. Numerical problems on, impending motion on horizontal and inclined planes (including connected bodies); wedge friction; Ladder friction and Belt friction.

Chapter 6: Simple Stress and Strain (06hours)

Introduction, Properties of Materials, Stress, Strain, Elasticity, Elastic limit, Hooke's law & Young's modulus, Stress – Strain Diagram for structural steel, working stress and Factor of safety. Deformation of a bar due to force acting on it. Law of superposition. Stresses in bars of

Uniform & varying cross sections. Composite sections. Problems connected to above topics.

Unit III

Chapter 7: Centroid of Plane Figures (05hours)

Introduction, Definition, Methods of determining the centroid, axis of reference, axis of symmetry, Locating the centroid of simple plane figures (triangle, semicircle, quarter of a circle and sector of a circle etc,.) using method of integration, Numerical problems on Centroid of simple built up sections.

Chapter 8: Second moment of area (Plane figures) (05hours)

Introduction, Definition, Method of determining the second moment of area, Section Modulus, Radius of gyration, perpendicular and Parallel axis theorems, Polar second moment of area, second moment of area of simple plane figures (triangle, rectangle, semicircle, circle etc,.) using method of integration, Numerical problems on MI of simple built up sections.

Text Books:

1. Beer, F.P. and Johnston, R., *Mechanics for Engineers: Statics*, McGraw Hill Company, New York, 1988.
2. Bhavikatti, S.S., and Rajasshekarappa K.G., *Engineering Mechanics*, 3Ed. NewAge International Pub. Pvt. Ltd., New Delhi, 2008.
3. Kumar,K.L., *Engineering Mechanics*, 3ed., Tata Mc Graw Hill Publishing Company,New Delhi, 2003.
4. Punmia, B.C., Jain, A. and Jain, A., *Mechanics of Materials*, Lakshmi Publications, New Delhi, 2006

Reference Books:

1. Jagadeesh, T.R. and Jayaram, *Elements of Civil Engineering*, Sapna Book House, Bangalore, 2006.
2. Ramamrutham,S., *Engineering Mechanics*, Dhanpat Rai Publishing Co., New Delhi, 1998.
3. Singer, F.L., *Engineering Mechanics*, 3rd edition Harper Collins, 1994.
4. Timoshenko, S.P. and Young, D.H., *Engineering Mechanics*, 4th edition, McGraw Hill Publishing Company, New Delhi, 1956.
5. Irving H Shames, *Engineering Mechanics*, 3rd edition, Prentice – Hall of India Pvt. Ltd, New Delhi - 110001, 1995.

Back to Semester I

Program: Biomedical Engineering	Semester: I

Course Title: C Programming for Problem solving		Course Code: 18ECSP101
L-T-P: 0-0-3	Credits:3	Contact Hours: 6hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hours: 72 Hrs.	Examination Duration: 3 Hrs.	

Introduction to Problem solving (03hours)

Introduction to algorithms / flow charts and its notations, top down design, elementary problems.

Basics of C programming language (15 hours)

Characteristics and uses of C, Structure of C program, C Tokens: Key words, Identifiers, Variables, Constants, Operators, Data-types, Input and Output statements.

Decision control statements (12hours)

Conditional branching statements: if statement, if else statement, else if ladder, switch statement, unconditional branching statements: break, continue. Introduction to Debugging Skills Introduction to Test Driven Programming.

Iterative statements (12hours)

while, do while, for, nested statements

Functions (10hours)

Introduction, Function declaration, definition, call, returns statement, passing parameters to functions, introduction to macros. Introduction to Coding Standards

Arrays and Strings (15hours)

Introduction, Declaration, Accessing elements, Storing values in arrays, Operations on one dimensional array, Operations on two dimensional arrays, Introduction to Code Optimization and refactoring.

Pointers (08hours)

Introduction, declaring pointer, pointer variables, pointer expression and arithmetic, passing arguments to functions using pointers, pointers and arrays, passing an array to a function.

Structures and Unions (05 hours)

Introduction, passing structures to functions, Array of structures, Unions

Text Books

1. R.G. Dromey, How to Solve it by Computer, 1ed, PHI, 2008.
2. Yashvant Kanetkar, Letus C, 15th ed, BPS Publication, 2016.

Reference Books:

3. B W Kernighan, DM Ritchie, The Programming language C, 2ed, PHI, 2004.
4. B S Gottfried, Programming with C, 2ed, TMH, 2006.
5. B. A. Forouzan, R.F. Gilberg, A Structured Program Approach Using C, 3ed, CENGAGE Learning, 2008.

Back to Semester I

Program: Biomedical Engineering		**Semester: I**
Course Title: Basic Electrical Engineering		**Course Code: 18EEEF101**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3hrs/week**
ISA Marks: 50	**ESA Marks:50**	**TotalMarks:100**
Teaching Hours:40Hrs	**Examination Duration: 3 Hrs**	

Unit I

Over view of Electrical Engineering (02hours)

Specialization, scope & role, impact of Electrical Engineering on national economy, environment, Sources of generation, sustainability, challenges and opportunities for electrical engineers, electrical engineering marvels, future challenges.

DC Circuits (05hours)

Voltage and current sources, Kirchhoff's current and voltage laws, loop and nodal analysis of simple circuits with dc excitation. Time-domain analysis of first-order RL and RC circuits.

AC Circuits (08hours)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase series and parallel R-L-C ac circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections. Power measurement using two watt meters.

Unit II

Electrical Actuators (09hours)

Electromagnetic principles, Solenoid, Relays, classification of Electric motors, DC motors- shunt, series, compound, separately excited, PM DC motors – Speed Control, Stepper Motors, BLDC motors, three phase induction motor, Characteristics and applications, selection of motors for various applications.

Power Electronics (Text1, chapter 45) (06hours)

Introductory, Thyristor, Some thyristor circuits, Limitations to thyristor operation, The thyristor in practice, The fully controlled AC/DC converter, AC/DC inversion, Switching devices in inverters, Three-phase rectifier networks, The three-phase fully controlled converter, Inverter- fed induction motors, Soft-starting induction motors, DC to DC conversion switched-mode power.

Unit III

Electrical Wiring, Safety and protection (Ref: Text 3 – page 1 to 10) (05hours)

Types of wires and cables for internal wiring, Types of switches and Circuits, Types of wiring, Safety precautions and rules in handling electrical appliances, Electric shock, first aid for electrical shocks, Importance of grounding and earthing, Methods for earthing, Fuses, MCB, ELCB and Relays, Lockout and Tag out, Electrical Codes and Standards.

Batteries (05hours)

Basics of lead acid batteries, Lithium Ion Battery, Battery storage capacity, Coulomb efficiency, Numerical of high and low charging rates, Battery sizing. Numerical.

Text Books

1. Hughes, Electrical & Electronic Technology, 8th, Pearson Education,2001
2. PC Sen, Principals of Electrical Machines and Power Electronics, 2nd, Wiley Publications
3. Gilbert M Masters, Renewable and efficient Electrical Power systems, Published by John Wiley & Sons 2004 edition
4. Frank D. Petruzella, Electric Motors and Control Systems, Mc Graw Hill Education Private Limited 2009 Edition

Reference Books:

1. DC Kulshreshtha, Basic Electrical Engineering, Mc Graw Hill Publications
2. David G Alciatore and Michel B Histand, Introduction to Mechatronics and Measurement Systems, 3rd, Tata Mc Graw Hill Education Private Limited, New Delhi., 2005
3. Vincent Del Toro, Electrical Engineering Fundamentals, 2nd edition Prentice Hall India

Back to Semester I

Program: Biomedical Engineering			**Semester: I**
Course Title: Design Thinking for Social Innovation			**Course Code: 15EHSP101**
L-T-P: 0-1-1	**Credits:2**		**ContactHours:3hrs/week**
ISA Marks: 80	**ESA Marks: 20**		**Total Marks: 100**
Teaching Hours: 28Hrs	**Examination Duration: 3Hrs**		

Module		**Topics**	**Assignments**	**Support activities/Tools**
KNOWLEDGE, TOOLS & DEVELOPMENT	**Course sensitization**	1. Introduction to Social Innovation: • Awakening social consciousness **(www.yourstory.com)** • Social Innovation and Leadership • Engineering & Social innovation (EPICS) **(Connecting S I Course to Mini Project, Capstone Project, Campus Placements)** • Course Overview • **Students' Self Introduction Activity** • Group formation **Activity**	**Reading assignments** • Read the handout on "The Process of Social Innovation" by Geoff Mulgan • Design thinking for Social Innovation **Written Assignments** • **Writing about Akshaya Patra in class. (Background information about Akshaya patra and the Social Cause it is addressing)** • **Brainstorming Session on Social Innovators in Class**	• Classactivity on Behavioural Blocks to Innovation **Discussion on the behavioural blocks.** • **Introducing oneselfwith three Adjectives- Appreciating diversity and discovering self** • **Group Formation Activity (Forming square) (Making four equilateral triangles out of popsicle sticks to enhance group Cohesiveness amongst the group mates)**

	Create Mindsets	**Seven Mindsets:** 1. Empathy **(Example of The Boy and the Puppies)** 2. Optimism **(Person Paralyzed waist down / Glass Healthful Half Empty)** 3. Iteration **(Thomas Alva Edison)** 4. Creative Confidence **(Origamy – Jose fAlbers)** 5. Making it 6. Embracing Ambiguity **(Confusion is the Welcome doormat at the door of Creativity)** 7. Learning from Failure **(Designing Website first and then asking the stake holders about the website)** **(Spending one lakh for The business which is never launched)**	**Reading assignments** • Handout on " Create Mindsets"	• **(How to Train the Dragon? Common Video for all the mindsets)** • **Watching in Class TED Talk on "How to build your Creative Confidence by David Kelley – IDEO Founder)**
	Process of Social Innovation	**Engage**	**Reading assignments** • Handout on Community Study	• Activity on Observation on skills To know How to

		Community study and Issue Identification	and Issue Identification • Case Study on "E GramSeva" • Case Study on "Janani Agri Serve" **Class Presentations** • Initial observations being made by the group **(Literature Survey of Places of Hubli-Dharwad)** **www.readwhere.com** • Detailed interaction / engagements with the society and finalize the social issue for intervention **Usetemplate1:Frame your Design Challenge**	Use one's observation skills in understanding the social conditions • Experience sharing by senior students • Brainstorming Deliberations on the initial observations and arrive at the "Social Issue" • Familiarization of the respective templates with the help of sample case study
		PEERREVIEW		
		2.Inspiration	**Reading assignments**	• Familiarization of the

		• Plan for the Research • Development of Interview guide • Capture your Learnings	• Handout on Overview of Inspiration **Class Presentations** • Entirety of the Social Issue • Identification of the Stake Holders **(Examples on Fluoroscent Curtain and Students' Punctuality for Class)** • Interview Questions **(Role Play on Interview with Stakeholders)** • Category wise Learnings capture **Use template 2: Plan your Research** **Template Development of Interview Guide** **Template4.Capture your Learning**	respective templates with the help of sample case study
		3. Ideation Synthesis • Search for meaning	**Reading assignments** • Handout on Overview of Ideation-Synthesis	• Familiarization of the respective

		• Create "How might we" question	**ClassPresentations** • Create insights • "How might we" questions **Use template 5: Create Insights** **Template 6: Create "How Might We' Questions**	templates with the help of sample Case study
		3.0Ideation **3.2Prototyping** • Generate Ideas • Select Promising Ideas • Determine what to prototype • Make your prototype • Test and get feedback	**Reading assignments** • Handout on Overview of Ideation-Prototyping **Class Presentations** • Story board- demonstrating the possible solutions **Use template 7: Select your best ideas** **Template 8 : Determine what to Proto type**	• Brain storming • Familiarization of the respective templates With the help of sample case study • Activity on Risk management • Activity on Resource management Structure building games
		PEERREVIEW		
		4.0 Implementation	**Reading assignments**	• Familiarization of the respective

		• Create an action plan • Community Partners (if any) • Budgeting & Fundraising 1. **Peer to Peer** 2. **Crowd Funding** 3. **Giving Kiosks** 4. **Donation** 5. **Envelop Funding** 6. **Marathons/ Walkathons** 7. **Conducting Yoga Classes** **(www.causevox.com / www.blog.fundly.com)** • Duration • Ethical concerns • Launch your solution • Feedback (Impact)	• Handout on Overview of Implementation **Class Presentations** • Pilot implementation plan with required resources and Budget indicating stake holders & their enagement	templates with the help of sample case study

		5.0 Reflect Reflection of the overall learning by the students	**Reading assignments** • Handout on Overview of students Reflection **Use template 9: Reflection on the Process** **Class Presentations** Final Presentation- After Implementation	• Familiarization of the respective templates with the help of sample case study

Back to Semester I

Program: Biomedical Engineering		**Semester: I**
Course Title: Engineering Physics lab		**Course Code: 16EPHP101**
L-T-P: 0-0-1	**Credits:1**	**Contact Hours: 2hrs/week**
ISA Marks: 80	**ESAMarks:20**	**Total Marks: 100**
Teaching Hours:24Hrs	**Examination Duration: 3 Hrs.**	
List of Experiments		
1.Fourprobemethod		
2.V-Icharacteristicsofp-njunctiondiode		
3.Zenerdiodecharacteristics		
4.Hysteresisloss		
5.Transistorcharacteristics		
6.Measurementofdielectricconstant		
7.ResonancefrequencyofLCRcircuits		
8.Studyoffrequencyresponseofpassivecomponents		
9.Calibrationofthermocouple		
10.Calibrationofelectricalmeters		

Back to Semester I

Program: Biomedical Engineering		**Semester: II**
Course Title: Multi variable calculus		**Course Code: 18EMAB102**
L-T-P: 4-1-0	**Credits:5**	**Contact Hours: 6hrs/week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours:50Hrs	**ExaminationDuration:3Hrs**	

Unit I

1. **Partial differentiation (12hours)**
   Function of several variables, Partial derivatives, Level curves, Chain rule, Errors and Approximations. Extreme value problems. Lagrange's multipliers.
2. **Double integrals (08hours)**
   Double integrals – Rectangular and polar coordinates, Change the order of integration. Change of variables, Jacobian. Application of double integrals **MAT LAB:** optimization problems, application of double integrals

Unit II

3. **Triple integrals (07hours)**

   Triple integrals, Cartesian, change to Cylindrical and Spherical coordinates Application of Triple integrals

4. **Calculus of Vector Fields (13hours)**

   Vector fields, Gradient and directional derivatives. Line and Surface integrals. Independence of path and potential functions. Green's theorem, Divergence of vector field, Divergence theorem, Curl of vector field. Stokes theorem.

MAT LAB: application of Triple integrals, Vector calculus problems

Unit III

1. **Differential equations of higher orders (5 + 5hours)**

   (a) Linear differential equations of second and higher order with constant coefficients. The method of Variation of parameters. Initial and boundary value problems.

   (b) Applications of second order differential equations-Newton's 2nd law, electrical circuits, Simple Harmonic motion. Series solution of differential equations. Validity of Series solution of Differential equations.

MAT LAB: application of differential equations

Text Books

1. EarlyTranscendentals Calculus-James Stewart, Thomson Books, 7ed2010.

Reference Books:

1. Calculus Single and Multivariable, Hughues - Hallett Gleason, Wiley India Ed, 4ed, 2009.
2. ThomasCalculus,GeorgeBThomas,PearsonIndia,12ed,2010

Back to Semester II

Program: Biomedical Engineering		**Semester: II**
Course Title: Engineering Chemistry		**Course Code: 15ECHB102**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3hrs/week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40Hrs	**Examination Duration: 3 Hrs**	

Unit I

1. Chemical Bonding (04hours)

Introduction, Ionic bond, factors influencing the formation of Ionic bond: Ionization energy. Electron affinity & electro negativity and properties of Ionic compounds. Covalent bond: Valence Bond theory & Molecular Orbital theory–formation of hydrogen molecule, factors influencing the formation of covalent bond, polar and non-polar covalent bond, dipole moment, problems on calculation of percentage of Ionic character and properties of covalent compounds, Co-ordinate bond: formation of hydronium ion and ammonium ion.

2. Electro chemical Energy Systems (06hours)

Electrode potential, Nernst equation, formation of a cell; Reference electrodes – Calomel electrode, Determination of electrode potential, numerical problems onE, E_{cell}& E^0_{cell}.

Batteries: Classification, Characteristics, Lead - acid, Lithium ion battery. Fuel cells - Methonol - O_2 fuel cell.

3. Polymers (06 hours)

Introduction, polymerization; mechanism of polymerization taking ethyleneasan example. Determination of molecular weight of a polymer – numerical problems. Commercial polymers - Plexi glass, PS, polyurethane.

Polymer composites: Carbon fiber and Epoxyresin – synthesis, properties and applications. Introduction to conducting polymers, mechanism of conduction in poly acetylene and applications.

Unit II

4. Plating Techniques (04hours)

Introduction, technological importance. Electroplating, Principles of electroplating. Factors affecting nature of electro deposit, throwing power, Numerical problems on throwing power, Electro plating process of gold by acid cyanide bath. Electro less plating, advantages of electro less plating over electroplating. Electro less plating of Cuandits application in the manufacture of PCB.

5. Wafer Technology (09hours)

Introduction, physical and chemical properties of silicon. Purification of silicon; chemical lvapor deposition (CVD) process, zone refining process. Crystal growth; preparation of single crystal silicon by Czhochralski crystal pulling technique – numerical problems. Crystal slicing and wafer preparation. Fabrication process: thermal oxidation, diffusion, ion implantation – numerical problems, epitaxial growth, masking and photolithography, wet etching, dry etching.

6. Material Chemistry (03hours)

Liquid Crystals – Types of liquid crystals, applications of Liquid Crystal in Display system.

Fluorescence and Phosphorescence – Jablonski diagram, Thermoelectric and Piezoelectric Materials–meaning, properties and applications.

Unit III

7. Instrumental methods of measurement(04hours)

Advantages over conventional methods. Electro analytical methods: Potentiometer - principle, methodology and applications. Optoanalytical methods: Colorimeter - Principle, methodology and applications.

Spectral methods of analysis: UV–Spectrophotometer – Instrumentation and applications.

8. Environmental Chemistry (04hours)

Water: Sources and ill effects of water pollutants – fluoride and nitrate; determination of total hardness of water by EDTA method – numerical problems. , Sewage: Determination of Biological Oxygen Demand by Winkler's method – numerical problems and determination of Chemical Oxygen Demand – numerical problems.

Text Books

1. A text Book of Engineering Chemistry, 1stedition, Dara.S.S, S.Chand&Co.Ltd., 2009, New Delhi.
2. A text Book of Engineering Chemistry, 16th edition, Jain P.C and Jain M, Dhanpat Rai Publications, 2006, New Delhi.

Reference Books:

1. Text book of Inorganic Chemistry, P.L. Soni, Sultan Chand, 1999, New Delhi.
2. Hand book of batteries, David Linden, Thomas B Reddy, 3rdedition Mc Graw Hill publications, 2001, New York.
3. Polymer Science, 6th Edition, Gowariker V.R., Viswanathan N.V., Sreedhar J., New Age International (P) Ltd, 2007, New Delhi.
4. Solid State Devices & Technology, 4th Edition, V. Suresh Babu, sanguine Technical Publishers, 2005, Bangalore.
5. Material Science & Engineering: An Introduction, 9th Edition, Calister William D, John Wiley and sons, 2007, New York.
6. Instrumental methods of Chemical analysis, 5th Edition, Gurudeep R Chatwal, Shan KAnand, Himalaya Publishing House Pvt. Ltd, 2010, Mumbai.
7. VLSI Technology, 2nd Edition, S.M. Sze, Mc Graw Hill Series in electrical and computer Engineering, 1998, New York.

Back to Semester II

KLE Technological University | Creating Value, Leveraging Knowledge

Program: Biomedical Engineering		**Semester: II**
Course Title: Problem Solving with Data Structures		**Course Code: 18ECSP102**
L-T-P: 0-0-3	**Credits:3**	**Contact Hours: 6hrs/week**
ISA Marks: 80	**ESA Marks:20**	**Total Marks: 100**
Teaching Hours: 78Hrs	**Examination Duration: 3 Hrs.**	

Pointers, Structures and Files (12hours)

Recap of basics: Pointers, Structures; Self – referential structures, dynamic memory management Files – File manipulation programs

Stacks and Recursion (16hours)

Stack: Definition, Operations, Stack ADT Implementation of stack operations. Applications of stack. Recursion- Need for Recursion and problems on Recursion.

Queues (16hours)

Queue: Definitions of Linear, Circular queues, Queue ADT Linear and circular queue operations Definition and working of Priority queue, Double ended queue; Applications of queues.

Lists(18hours)

Concept of lists and dynamic memory management lists, definitions and representations: singly, doubly, circular lists. Dynamic Implementation of lists and its operations, Applications
Of linked lists

Binary trees (16 hours)

Binary Tree: Definition, Terminology and representation, Tree Traversals both recursive and iterative. Binary Search Tree and its applications.

Text Books:

1. Data Structures with C -- SeymourLipschutz, Schaum's Outline Series
2. Data Structures Using Cand C++ -- Langsam and Tanenbaum,PHI Publication
3. Data Structures Through C – Yashavant P Kanetkar, BPB Publication

Reference Books:

1. BW Kernighan, DM Ritchie, The Programming language C, 2ed, PHI, 2004.
2. B S Gottfried, Programming with C, 2ed, TMH, 2006.
3. B.A. Forouzan, R.F. Gilberg, A Structured Program Approach Using C, 3ed, CENGAGE Learning, 2008.

Back to Semester II

Program: Biomedical Engineering		**Semester: II**
Course Title: Engineering Exploration		**Course Code: 15ECRP101**
L-T-P: 0-0-3	**Credits:3**	**Contact Hours: 6hrs/week**
ISA Marks:80	**ESA Marks:20**	**Total Marks: 100**
Teaching Hours:78Hrs	**Examination Duration : 3Hrs**	
List of Experiments		
1.Introduction to Engineering and Engineering Study		
2.Role of Analysis in Engineering, Analysis Methodology		
3.Data Analysis Graphing		
4.Basics of Engineering Design, Multidisciplinary Nature of Engineering Design		
5.Project Management		
6.Sustainability in Engineering		
7.Ethics		
8.Modelling, Simulation and Data Acquisition using Software Tool		
9.Platform based development: Arduino		
10.Course Project		

Reference Books:

1. Engineering Fundamentals& Problem Solving by Arvid Eide, Roland Jenison, Larry Northup, Steven, Mc Graw Hill Higher Education, 6th Edition (2011)
2. Engineering Exploration (Edited Book, 2008) by Pearson Publication

Back to Semester II

KLE Technological University | Creating Value, Leveraging Knowledge

Program: Biomedical Engineering			**Semester: II**
Course Title: Basic Electronics			**Course Code: 18EECF101**
L-T-P: 4-0-0	**Credits:4**		**Contact Hours: 4Hrs/week**
ISA Marks: 50		**ESA Marks:50**	**Total Marks:100**
Teaching Hours :50Hrs		**Examination Duration: 3Hrs**	

Content

Unit I

Chapter1: Trends in Electronic Industries: (03hours)

Introduction, Roadmap of electronic sector, scope and opportunities in various segments of electronics (i.e., Consumer, Telecom, IT, Defense, Industrial, Medical and Automobiles), Government and private sectors, Growth profile of Electronic industries, Standards and PoliISAs, Electronic System Components.

Chapter2 : Basic Components, Devices and Applications:(10 hours)

Diode: PN junction characteristics; modeling as a circuit element, ideal and practical diode. AC to DC converter: Half wave and full wave rectifier (centre tap and bridge), capacitor filter and its analysis, numerical examples. Zener diode and its applications (Voltage reference and voltage regulator). Realization of simple logic gates like AND and OR gates.

Chapter3:Transistor: (07hours)

BJT, transistor voltages and currents, Signal amplifier (Fixed bias, Collector base bias, Voltage divider bias, CE configuration). DC load line. Voltage, current and power gains. Transistor as a switch: NOT Gate, Basic (DTL) NAND gate. Transistor as a Small Signal Amplifier (Single Stage and Two Stage RC- coupled Amplifiers).

Unit II

Chapter 3: Digital Logic: (14hours)

Number systems: Decimal, Binary, Octal and Hexadecimal number systems, Conversions, Binary Operations-Addition and subtraction in binary number systems. Logic gates: Realization of simple logic functions using basic gates (AND, OR, NOT), Realization using universal gates (NAND, NOR). Boolean algebra: Theorems and postulates, De Morgan's Theorems, simplification of logical expressions,KarnaughMaps,UseofKarnaughMapstoMinimizeBooleanExpressions(2Variables, 3 Variables and 4 Variables, Design of Half Adder and Full Adder, Parallel Adder using full adders.

Chapter4:OperationalAmplifier:(06hours)

OPAMP characteristics (ideal and practical), Linear and non-linear applications: Inverting amplifier, Non inverting amplifier, Voltage follower, Integration, Differentiation, Adder, Subtractor, ZCD and Comparator.

Unit III

Chapter 5: Communication Systems: (07hours)

Basic block diagram of communication system, types of modulation. Amplitude modulation: Time- Domain description, Frequency-Domain description. Generation of AM wave: square law modulator. Detection of AM waves: envelope detector. Double side band suppressed carrier modulation (DSBSC), Generation of DSBSC wave: balanced modulator, Super heterodyne principle.

Chapter6 : Linear Power Supply, UPS & CRO: (03hours)

Working principle of linear power supply, UPS and CRO. Measurement of amplitude, frequency and phase of a given signal.

Text Book:

1. David A Bell, Electronic devices and Circuits, PHI New Delhi, 2004
2. K.A Krishnamurthy and M.R. Raghuveer, Electrical, Electronics and Computer Engineering for SIS Antist and Engineers, 2, New Age International Publishers, 2001
3. A.P. Malvino, Electronic Principles, Tata Mc GrawHill,1999

References:

1. George Kennedy, Electronic Communication Systems, Tata Mc Graw Hill, 2000
2. Morris Mano, Digital logic and Computer design, 21st Indian print Prentice Hall India, 2000
3. Floyd, Digital fundamentals, 3, Prentice Hall India, 2001
4. Boylestead Nashelsky, Electronic devices & Circuit theory, Prentice Hall India,2000
5. Ramakant Gaikawad, Operational Amplifiers & applications, PHI, 2000

Back to Semester II

Course Title: Basic Mechanical Engineering		Course Code: 15EECF101
L-T-P: 2-1-0	Credits:3	Contact Hours: 4hrs/week
ISA Marks: 50	ESA Marks:50	Total Marks: 100
Teaching Hours: 25 + 25Hrs	Examination Duration: 3 Hrs.	

Unit I

Chapter 1: Introduction to Mechanical Engineering: (02hours)

Definition of engineering, Mechanical Engineering, Branches of Mechanical Engineering, Who are Mechanical Engineers? Mechanical Engineers' top ten achievements. Visit to Workshop and Machine Shop, Tools, Safety Precautions Video presentations

Chapter2 : Manufacturing Engineering: Basics of Manufacturing (08hours)

What is manufacturing? The main manufacturing sectors, The importance of the main manufacturing sectors to the Indian economy, Scales of production Classification of manufacturing Processes.

Advances in Manufacturing: CNC machines, Mechatronic and applications Demonstration on working of Lathe, milling, drilling, grinding machines Demon stration on Welding (Electric Arc Welding, Gas Welding, Soldering) Demonstration and Exercises on Sheet metal work.

Visit to Learning Factory

Unit II

Chapter3: Design Engineering: Power Transmission Elements (06hours)

Overview

Design Application:

- Belt Drives. Types, Length of Belt. Velocity Ratio, Initial Tension. Ratio of Tensions. Power Transmitted, Numerical Problems.
- Gears. Spur Gear, Rack and Pinion, Worm Gear, Bevel Gear, Helical Gears. Speed, Torque, and Power in Gear pair. Simple and Compound Gear trains. Numerical Problems.
- Ball and Roller Bearings, Types, Applications.

Design Problems like a moving experience, aluminum can crusher Video presentations

Chapter4: Thermal Engineering 1: Prime Movers. (04hours)

Internal Combustion Engines: Classification, IC engine parts, 2 stroke SI and CI engine , 4 Stroke SI and CI Engine, PV diagrams of Otto and Diesel cycles, Comparison of 2 stroke and 4 stroke engine, comparison of CI and SI engine, Problems on Engine Performance, Future trends in IC engines.

Case study on power requirement of a bike, car or any machine

Video presentations

Unit III

Chapter5 : Thermal Engineering 2 : Thermal Systems' Applications(05hours)

Refrigeration system, Air conditioning system, Pumps, Blowers and Compressors, Turbines, and their working principle and specifications.

Case study on selection of various thermal systems

Video presentations

Text Books

1. Jonathan Wickert and Kemper Lewis, an Introduction to Mechanical Engineering, Third Edition, 2013 - Cengage Learning. 4

2. K.R.Gopalkrishna, Sudhir Gopalkrishna, S.C. Sharma. A Text Book of Elements of Mechanical Engineering, 30th Edition, Oct 2010,–Subhash Publishers, Bangalore.

Reference Books:

1. Course Material developed by the Department to Mechanical Engineering.
2. S K H Chowdhary, AKH Chowdhary, Nirjhar Roy, The Elements of Workshop Technology- Vol I & II , 11th edition 2001, Media Promoters and Publishers.
3. Basic Manufacturing, Roger Timings, Third edition, Newnes, An imprint to fElsevier

Back to Semester II

Program: Biomedical Engineering		**Semester: II**
Course Title: Professional Communication		**Course Code: 15EHSH101**
L-T-P: 1-1-0	**Credits:2**	**Contact Hours: 3hrs/week**
ISA Marks: 50	**ESA Marks:50**	**Total Marks:100**
Teaching Hours: 42Hrs	**Examination Duration:3 Hrs**	

List of Experiments

Chapter No. 1. Basics – English Communication (09hours)

Course Introduction, Explanation of template mix-ups with correct usages & necessity of grammar in error detection, Usage of tenses

Chapter No.2.Vocabulary and grammar(06hours)

Vocabulary, Word Formation and Active and Passive Voice

Chapter No.3. Bouncing Practice(06hours)

Definition and types of bouncing and its practice with examples, reading skills, free style speech. Individual presentation.

Chapter No.4. Rephrasing and Structures (08hours)

Comprehension and Rephrasing, PNQ Paradigm and Structural practice.

Chapter No.5.Dialogues (03hours)

Introduction of dialogues, Situational Role-plays.

Chapter No.6. Business Communication (09hours)

Covering letter, for mall Etters, Construction of paragraphs on any given general topic.

Reference Books:

1. Collins Cobuild Advanced Learner's English Dictionary
2. Raymond Murphy – Intermediate English Grammar, Cambridge University Press
3. MartinHewings – Advanced English Grammar, Cambridge University Press.

Back to Semester II

Course Content (3rd Sem)

Course Code: 15EMAB203	Course Title: Integral transforms and Statistics	
L-T-P : 4-0-0	Credits: 4	Contact Hrs.: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 4		Exam Duration: 3 hours

Content	Hrs.
Unit - 1	
1. Laplace Transforms Definition, transforms of elementary functions- transforms of derivatives and integrals- Properties. Periodic functions, Unit step functions and Unit impulse functions. Inverse Transforms- properties- Convolution Theorem. Initial and Final value theorems, examples; Applications to differential equations, Circuit equations	**10 hrs.**
2. Probability Definition of probability, conditional probability, Baye's rule, Chebyshev's inequality, random variables- PDF-CDF- Probability Distributions: Binomial, Poisson, Exponential, Uniform,and Normal	**10hrs.**
Unit - 2	
3. Regression Introduction to method of least squares, fitting of curves:$y = a + bx$,$y = a + bx + cx^2$, $y = ab^x$, correlation and regression. Engineering problems	**05 hrs.**
4. Fourier Series: Complex Sinusoids, Fourier series representations of four classes of signals, Periodic Signals: Fourier Series representations, Derivation of Complex Co - efficient of Exponential Fourier Series and Examples. Convergence of Fourier Series. Amplitude and phase spectra of a periodic signal. Properties of Fourier Series(with proof): Linearity, Symmetry Properties, Time shift, Frequency Shift, Scaling, Time differential differentiation coefficients, Time domain Convolution, Multiplication Theorem, Parseval's theorem and Examples on these properties.	**08 hrs.**
5. Fourier Transform: Fourier representation of non-periodic signals, Magnitude and phase spectra. Properties of Fourier Transform: Linearity, Symmetry Properties, Time shift, Frequency Shift, Scaling, Time differential differentiation coefficients, Time domain Convolution, Multiplication Theorem, Parseval's theorem and Examples on these properties.	**07 hrs.**
Unit - 3	
6. Random Process (a) Introduction to Joint Probability Distributions, marginal distribution, joint pdf and cdf, mean, variance, covariance, correlation. (b) Introduction to Random process, stationary process, mean, correlation and covariance function, autocorrelation function, cross correlation, Power spectral Density: properties of the spectral density; Gaussian Process: Properties of Gaussian process.	**10hrs.**
Text Books	

1. Kreyszig E., Advanced Engineering Mathematics, 8ed, John Wiley & sons, 2003.
2. Gupta S C and Kapoor V K, Fundamentals of Mathematical Statistics, 9ed, Sultan Chand & Sons, New Delhi, 2002
3. Walpole and Myers, Probability and Statistics for Engineers and Scientists,8ed, Pearson Education – Delhi – 2007

Reference Books:

1. Simon Haykin, Barry Van Veen, Signals and Systems, John Wiley, 2002.
2. J. Susan Milton, Jesse C. Arnold, Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences, 4th Ed, TATA McGraw-Hill Edition 2007
3. Ian Glover & Peter Grant, Digital Communications, 2nd Ed, Pearson 2012.

Course Content

Course Code: 22EBMC201	Course Title: Circuit Analysis	
L-T-P: 4-0-0	Credits: 4	Contact Hrs.: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs.: 50		Exam Duration: 3 hrs.

Content	Hrs.
Unit - 1	
Chapter No. 1. Basic Concepts Active and passive circuit elements, Voltage & current sources, Resistive networks, Nodal Analysis, Super node, Mesh Analysis, Super mesh, Star – Delta Transformation. [Text 1: Chapter 4,5, 7]	6 hrs.
Chapter No. 2. Network Theorems Homogeneity, Superposition and Linearity, Thevenin's & Norton's Theorems, Maximum Power Transfer Theorem, Miller's theorem, Reciprocity principle. [Text 1 : Chapter 5]	8 hrs.
Chapter No. 3. Two Port Networks Two port variables, Z, Y, H, G, A- Parameter representations, Input and output impedance calculation, Series, Parallel and Cascade network connections, and their (suitable) models. [Text 2 : Chapter 11]	6 hrs.
Unit - 2	
Chapter No. 4. Network topologies Graph of a network, Concept of tree and co-tree, incidence matrix, tie set and cut set schedules, Formulation of Equilibrium equations in matrix form, Solution of resistive networks.[Text 1: Chapter 5]	4 hrs.
Chapter No. 5. Time and Frequency domain Representation of Circuits Order of a system, Concept of Time constant, System Governing equation, System Characteristic equation, Initial conditions, Transfer Functions (Fourier and Laplace domain representation)	6hrs
Chapter No. 6. First order circuits Transient response of R-C and R-L networks (with Initial conditions) Concept of phasor, Phasor diagrams, Frequency response characteristics, R-C , R-L circuits as differentiator and integrator models, time and frequency domain responses R-C , R-L circuits as Low pass and high pass filters [Text 2: Chapter 5, Text 1: Chapter 8,9,10]	8 hrs.
Unit - 3	
Chapter No. 7. Higher order circuits Higher order R-C, R-L and R-L-C networks, time domain and frequency domain representation, Series R-L-C circuit, Transient response for Impulse and Step inputs , Damping factor, Performance parameters. **Chapter No. 8. Resonance** Frequency response curve, Series and Parallel Resonance, Quality factor, Selectivity and Bandwidth [Text 2: Chapter 7,8] [Text 1: Chapter 4,5, 7]	6hrs 6 hrs.

Text Books (List of books as mentioned in the approved syllabus):

4. Hayt, Kemmerly, and Durbin, Engineering Circuit Analysis, 8th Edition, McGraw Hill 2012 (Indian Edition).
5. Van Valkenburg, Network Analysis, 3 Edition, Pearson, 2010

References:

6. Joseph Edminister, MahmoodNahavi, Electric Circuits, 3, McGraw Hil,, 2010
7. Robbins and Miller, Circuit Analysis- Theory and Practice, 5th Edition, Cengage Learning, 2012
8. Charles Alexander, Matthew Sadiku, Fundamentals of Electric Circuits, 7th Edition, McGraw-Hill Education; 7th Edition,2020

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Course Code: 22EBMC202	Course Title: Analog Electronic Circuits	
L-T-P-Self Study: 4-0-0-0	Credits: 4	Contact Hrs.: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs.: 50		Exam Duration: 3 hrs.

Course Content

Content	Hrs
Unit - 1	
Chapter 1:Diode Models and Circuits Recap of diode models: Exponential model, piece-wise linear model, constant voltage drop model, ideal diode model, small signal diode model and derivation of small signal diode resistance. Applications of diodes as a Clipping and clamping circuits with and without DC bias voltage; Voltage doublers. Numericals on applications. (T1: 2.2, 2.3.1 to 2.3.8, 2.6.1to 2.6.3.)	6 hrs.
Chapter 2: Bipolar junction transistors Recap of DC load line and bias point, Small signal operation-the transfer characteristics, the amplifier gain, and operation as a switch. Biasing of BJT: voltage divider, Small signal models of bipolar transistors, two port modeling of amplifiers, H-model, ac analysis of BJT circuits-coupling and bypass capacitor, Common emitter circuit analysis without R_E resistance(Emitter resistor) (T1: 3.2.1,3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.3.2, 3.3.4)	5 hrs.
Chapter 3: MOSFETs structure and physical operation: MOSFET Device structure, NMOS :Depletion type ; operation with no gate voltage, positive and negative gate voltage and Enhancement type ; operation with no gate voltage, positive and negative gate voltage creating a channel for current flow, applying small v_{ds}, operation as v_{ds} is increased, Derivation of threshold voltage of MOSFET, Operating the MOS transistor in the sub threshold region, Pinch off effect , channel length modulation effect , derivation of the I_D-V_{DS} relationship, with and without channel length modulation. Finite output resistance (r_{ds} on) in saturation, PMOS: Drain and Transfer characteristics, circuit symbol, the I_D v/s V_{DS} characteristics, and the role of the substrate-the body effect, temperature effects, breakdown and input protection. MOSFET circuits at DC	9 hrs.
Unit - 2	
Chapter 4: Biasing of MOSFETs MOSFET circuits at DC continued. Biasing in MOS amplifier circuits, By fixing V_{GS}; By fixing V_G; With drain to gate feedback resistor; Constant current source biasing, MOSFET as a switch Large – signal operation, operation as a linear amplifier and Numerical. (T1:4.3)	8 hrs.
Chapter 5: MOSFET amplifiers Small signal operation and models, single stage MOS amplifiers, the MOSFET internal capacitance, Derivation of CS , CG and CD amplifiers parameters and its comparison, Implications on gain and Bandwidth. Source degenerated common source amplifier, cascode and cascaded circuits High frequency model of the MOSFET, revision of common-gate, common- source, common-drain circuits; poles and zeros in the transfer function (T1:4.4,4.5, 4.6.1 to 4.6.7 ; 4.7.1, 4.7.2, 4.7.3, 4.7.5, 4.7.6, 4.7.7;4.8.1,4.8.2, 4.8.3,4.8.4, 4.9.1 to 4.9.3)	12 hrs.
Unit - 3	
Chapter 6: Feedback Amplifiers General feedback structure (Block schematic),Types of feedback topologies, series-shunt feedback amplifier, series-series feedback amplifier, and shunt-shunt and shunt-series feedback amplifier with examples , Feedback de-sensitivity factor, positive and negative feedback Nyquist stability Criterion, RC phase shift oscillator, Wein bridge Oscillator, merits of negative feedback, feedback topologies: (T1:7.1 to 7.6)	5 hrs.
Chapter 7: Large Signal Amplifiers Classification of amplifiers: (A, B, AB and C); Transformer coupled amplifier, push-pull amplifier Transistor case and heat sink. Derivation of power efficiency and power dissipation.(T1:12.1 to 12.6;12.8.4)	5 hrs.

Text Books (List of books as mentioned in the approved syllabus)

1. A.S. Sedra& K.C. Smith, Microelectronic Circuits, 5th Edition, , Oxford Univ. Press, 1999
2. Jacob Millman and Christos Halkias, Integrated Electronics, McGraw Hill
3. Electronic Devices and Circuit Theory, Robert Boylestad Louis Nashelsky, 11th Edition, Pearson, 2015

References

1. David A. Bell, Electronic Devices and Circuits, 4th edition, PHI publication, 2007
2. Grey, Hurst, Lewis and Meyer, Analysis and design of analog integrated circuits, 4th edition
3. Thomas L. Floyd, Electronic devices, Pearson Education, 2002
3. Richard R. Spencer & Mohammed S. Ghousi, Introduction to Electronic Circuit Design, Pearson Education, 2003
4. J. Millman& A. Grabel , Microelectronics , 2nd edition, McGraw Hill, 1987

Course Content

Course Code: 19EBMC201	Course Title: Digital Circuits	
L-T-P-Self Study: 4-0-0-0	Credits: 4	Contact Hrs.: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs.: 50		Exam Duration: 3 hrs.

Content	Hrs.
Unit – 1	
Chapter No. 1. Logic Families Logic levels, output switching times, fan-in and fan-out, comparison of logic families.	3 hrs.
Chapter No. 2. Principles of Combinational Logic Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3,4 variables, Incompletely specified functions(Don't care terms),Simplifying Maxterm equations, Quine - McCluskey minimization technique - Quine-Mc Cluskey using don't care terms, Reduced Prime Implicant Tables.	10hrs
Chapter No. 3. Analysis and design of combinational logic General approach, Decoders-BCD decoders, Encoders, Digital multiplexers- Using multiplexers as Boolean function generators. Adders and subtractors-Cascading full adders, Look ahead carry adders, Binary comparators.	8hrs
Unit – 2	
Chapter No. 4. Introduction to Sequential Circuits Basic Bistable Element, Latches, A SR Latch, Application of SR Latch, A Switch De bouncer, The SR Latch, The gated SR Latch, The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The Master-Slave SR Flip-Flops, The Master-Slave JK Flip-Flop, Edge Triggered Flip-Flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop; Characteristic Equations.	10hrs
Chapter No. 5. Analysis of Sequential Circuits Registers and Counters, Binary Ripple Counters, Synchronous Binary counters, Ring and Johnson Counters, Design of a Synchronous counters, Design of a Synchronous Mod-n Counter using clocked JK Flip-Flops Design of a Synchronous Mod-n Counter using clocked D, T or SR Flip-Flops.	10hrs
Unit – 3	
Chapter No. 6. Sequential Circuit Design Introduction to Sequential Circuit Design, Mealy and Moore Models, State Machine notations, Synchronous Sequential Circuit Analysis, Construction of state Diagrams and counter design.	5hrs
Chapter No. 7. Introduction to memories Introduction and role of memory in a computer system, memory types and terminology, Read Only memory, MROM, PROM, EPROM, EEPROM, Random access memory, SRAM, DRAM, NVRAM.	4hrs

Text Books (List of books as mentioned in the approved syllabus)

1. Donald D Givone, Digital Principles and Design, Tata McGraw Hill Edition, 2002

2. John M Yarbrough, Digital Logic Applications and Design, Thomson Learning, 2001

3. A Anand Kumar , Fundamentals of digital circuits, PHI, 2003

References

1. Charles H Roth, Fundamentals of Logic Design, Thomson Learning, 2004
2. ZviKohavi, Switching and Finite Automata Theory, 2nd, TMH
3. R.D. Sudhaker Samuel, Logic Design, Sanguine Technical Publishers, 2005
4. R P Jain, Modern Digital Electronics, 2nd, Tata McGraw Hill , 2000

Course Content

Course Code: 22EBMC203	Course Title: Electronic Instrumentation and Measurements	
L-T-P-Self Study: 4-0-0	Credits: 4	Contact Hrs.: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs.

Content	Hrs.
Unit - 1	
Chapter 1: Fundamentals of Measurements: Introduction, Significance of measurements, methods of measurements, instruments and measurement systems, Functions of instruments and measurement systems, Applications of measurement systems. **Measurement Errors**: Introduction Gross errors and systematic errors, Absolute and relative errors, basic concepts of accuracy, Precision, Resolution and Significant figures, Measurement error combinations. **Units and Dimensions:** Review of fundamental and derived units, SI units, dimensional equations.	10 hrs.
Chapter 2: Ammeters, Voltmeter and Multimeters: Introduction, DC ammeter principle only, DC voltmeter, Multi-range voltmeter, Extending voltmeter ranges, Loading, Peak responding and True RMS voltmeters. (relevant problems) **Digital Voltmeters**: Introduction, Ramp type, Dual slope integrating type (V–T), integrating type (V–F) and Successive approximation type (relevant problems). **Digital Instruments**: Introduction, Block diagram of a Basic Digital Multi-meter. Digital frequency meters: Basic circuit of a Digital frequency meter, Basic circuit for frequency measurement	10 hrs.
Unit - 2	
Chapter 3: Oscilloscopes: Introduction, Basic principles, CRT features, Block diagram and working of each block, Typical CRT connections, Dual beam and dual trace CROs, Electronic switch. **Analog storage oscilloscopes:** Need for trace storage, bistable storage CRT, Variable persistence storage CRT. **Digital storage oscilloscopes:** Block diagram and operation.	8 hrs.
Chapter 4: Signal Generators and Bridges: Introduction, Fixed and variable AF oscillator, Standard signal generator, Modern laboratory signal generator, AF sine and Square wave generator, Function generator, Square and Pulse generator. Bridge Circuits for Measurement of R, L & C: **DC bridges:** Introduction, Wheatstone bridge, Kelvin Bridge **AC bridges:** Capacitance Comparison Bridge, inductance Comparison Bridge, Maxwell's bridge, Schering Bridge.	12 hrs.
Unit - 3	
Chapter 5: Display Devices and Recorders: Introduction, electrical indicating instruments, digital instruments, digital display methods, digital display unit. **Segmental Displays:** Seven segmental display, dot matrices, LED, LCD, decade counting assemblies, display systems **Recorders:** Recording requirements, analog recorders- Graphic recorders, strip chart recorders & its types, X-Y recorder, Magnetic & Digital tape recorders	10 hrs.

Text Books (List of books as mentioned in the approved syllabus) 1. Electronic Instrumentation, H. S. Kalsi, TMH, 2004 2. Electronic Instrumentation and Measurements", David A Bell, PHI / Pearson Education2006/ Oxford Higher Education, 2013. 3. Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), Dhanpat Rai & Co. Pvt. Ltd., 2004	
References 1. Principles of Measurement Systems", John P. Beately, 3rd Edition, Pearson Education, 2000 2. Modern Electronic Instrumentation and Measuring Techniques", Cooper D & A D Helfrick, PHI, 1998.	

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Demonstration		**Total Weightage: 5.00**		**No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Characterization of TTL Gates– Propagation delay, Fan-in, Fan-out and Noise Margin.	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. Realize and verify the functionalities of logic gates and universal gates. 2. Analyze performance metrics of TTL gates			Logic Families
2	To verify of Flipflops (a) JK Master Slave (b) T-type and (c) D-Type	1.00	0.00	
	Learning Outcomes: The students should be able to: 1. Realize and verify the functionalities of flip flops using.			Introduction to Sequential Circuits
Category: Exercise		**Total Weightage : 4 .00**		**No. of lab sessions: 5.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Design and implement binary to gray, gray to binary, BCD to Ex-3 nd Ex-3 to BCD code Converters.	1.00	6.00	
	Learning Outcomes: The students should be able to: 1. Design and verify code converters			Analysis and Design of Combinational Logic
2	Design and implement BCD adder and Subtract or using 4 bit parallel adder	1.00	7.00	
	Learning Outcomes: The students should be able to: 1. Design decimal adder / subtract using parallel adders.			Analysis and Design of Combinational Logic
3	Design and implement n bit magnitude comparator using 4- bit comparators	1.00	6.00	

	Learning Outcomes: The students should be able to: 1. Design and verify the 1 bit and 2 bit comparators using logic gates. 2. Design and realize the n bit comparator using 4 bit Comparators.			Analysis and Design of Combinational Logic
4.	Design and implement 8:3 Priority Encoder. (6M) Learning Outcomes: The students should be able to: 1. Design and realize 8:3 Priority Encoder.			Analysis and Design of Combinational Logic
5.	Design and implement frequency divider. (6M) Learning Outcomes: The students should be able to: 1. Design and realize frequency divider.			Analysis and Design of Sequential Logic
6	Design and implement Ring and Johnson counter using Shift register.	1.00	7.00	
	Learning Outcomes: The students should be able to: 1. Configure shift registers to realize Ring & Johnson counter. 2. Plot the timing diagram for shift registers			Analysis of Sequential Circuits
7	Design and implement mod-6 synchronous and asynchronous counters using flip flops	1.00	7.00	
	Learning Outcomes: The students should be able to: 1. Construct the transition & excitation tables for any sequential network. 2. Design mod-n counter using flip flops			Analysis of Sequential Circuits
Category: Structured Enquiry		**Total Weightage: 3 .00**		**No. of lab sessions: 4.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Multiplexers and decoders Design and implement given functionality using decoders and multiplexers	2.00	15.00	

	Learning Outcomes: The students should be able to: 1. Realize any given Boolean expression using Multiplexers and decoders. 2. Simulate the circuit using an IDE tool.			Analysis and design of combinational logic
2	Design and implement a digital system to display a 3 Bit counter on a 7 segment display. Demonstrate the results on a general Purpose PCB.	2.00	15.00	
	Learning Outcomes: The students should be able to: 1. Select the best design technique. 2. Simulate the circuit using an IDE tool.			1. Analysis and design of Combinational logic 2. Introduction to Sequential Circuits 3. Analysis of Sequential Circuits

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Demonstration		**Total Weight age: 0.00**		**No. of lab sessions: 1.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Study of multimeters, power supplies, function generators, Oscilloscopes; Identification of various components and devices, e.g. resistors, capacitors,diodes,transistors	1.00	0.00	
	Learning Outcomes: The students should be able to: 1. Identify & use different circuit components/ devices and also the equipment's to be used for measurements.			Introduction
Category: Exercise		**Total Weight age: 48.00**		**No. of lab sessions: 7.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Title: Design & analyze Diode Clipping (single/double ended) circuits.	1.00	8.00	*Diode applications*
	Learning Outcomes: The students should be able to: 1. To illustrate the effect of changing the reference voltage on clipping action of the diode. 2. To illustrate the function of diode in following circuits 1. Positive clipping 2. Negative clipping 3. Two way clipping			
2	Design & analyze Positive and Negative Clamping circuits	1.00	8.00	Diode applications
	Learning Outcomes: The students should be able to: 1. To illustrate the effect of dc restorer on the input signal 2. To illustrate the function of diode in following circuits 1. Positive clamping 2. Negative clamping			
3	Study of BJT as a Switch	1.00	5.00	BJT applications
	Learning Outcomes: The students should be able to: 1. Understand the operation of bipolar transistor as a switch and analyze basic digital gate circuits			

4	Study the input and output characteristics of MOSFET	1.00	8.00	MOSFET
	Learning Outcomes: The students should be able to: 1. Explain the concept of threshold voltage in MOSFET. 2. To determine the drain and transfer characteristics of MOSFET and realize the importance of Threshold voltage			
5	To study the basic current mirror circuit	1.00	8.00	MOSFET
	Learning Outcomes: The students should be able to: 1. To determine the constant current source using current mirror circuit with BJT/MOSFET			
6	MOSFET as a source follower (Buffer)	1.00	5.00	MOSFET
	Learning Outcomes: The students should be able to: 1. To explain the VGS voltage over VDS. 2. To illustrate the effect of varying ID current.			
7	Study of transformer-less Class B push pull power amplifier and determination of its conversion efficiency	1.00	6.00	POWER AMPLIFIER
	Learning Outcomes: The students should be able to: 1. Design class B push-pull amplifier for the given conversion efficiency. 2. Differentiate between Small signal and large signal amplifiers 3. Explain cross-over distortion in large signal amplifier and how it is overcome.			
8.	Design and analysis of BJT as RC phase shift oscillator Learning Outcomes: The students should be able to: 1. Condition for oscillations. 2. Feedback topology. 3. Design of BJT as RC phase shift oscillator.			Feedback Topologies
Category: Structured Enquiry		**Total Weight age: 20.00**		**No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	To determine the frequency response of RC Coupled single stage BJT amplifier(CE mode)&also the gain, input & output impedances	1.00	10.00	BJT Applications
	Learning Outcomes:			

	The students should be able to: 1. Determine the performance parameters of the following Amplifiers using BJT. a. Single stage RC coupled amplifier			
Category: Open Ended		**Total Weight age: 12.00**		**No. of lab sessions: 1.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Design a regulated power supply for the given specifications	1.00	12.00	DIODE/BJT/MOSFET
	Learning Outcomes: The students should be able to: 1. To determine the efficiency of the fixed regulated power supply			

Course Content

Course Code: 22EBMF202	Course Title: Microcontroller Architecture & Programming	
L-T-P-Self Study: 2-0-1	Credits: 3	Contact Hrs: 52
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 30		Exam Duration: 2hrs

Content	Hrs
Unit - 1	
Chapter 1: Microprocessors and Microcontroller Introduction, Microprocessors and Microcontrollers, A Microcontroller Survey, RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture.	2 hrs
Chapter 2: The 8051 Architecture 8051 Microcontroller Hardware, Input / Output Pins, Ports and Circuits, semiconductor Memories, Interfacing external RAM & ROM memories.	4 hrs
Chapter 3: Addressing Modes and Operations Addressing modes, External data Moves, Code Memory, Read Only Data Moves / Indexed Addressing mode, Data exchanges, stack concept and related instructions, example programs. Arithmetic Operations: Introduction, Flags, Incrementing and Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic, Example Programs. Logical Operations: Introduction, Byte level, logical Operations, Bit-level Logical Operations, Rotate and Swap Operations, Example Programs, Jump Operations: Introduction, The JUMP and CALL, Program range, Jump calls and Subroutines Interrupts and Returns, Example Problems.	5 hrs
Chapter 4: 8051 Programming in 'C' Data Types and Time delays in 8051C, I/O Programming, Logic operations, Data Conversion programs, Accessing code ROM space, Data serialization.	3 hrs
Unit - 2	
Chapter 5: Counter/Timer Programming in 8051 Introduction, Timer SFRs, Programming 8051 Timers, Programming Timer0 and Timer1 in assembly and c language.	4 hrs
Chapter 6: Serial Communication Basics of Serial Communication, 8051 connections to RS-232,8051 Serial Communication modes, Programming, Serial port programming in C.	4 hrs
Chapter 6:8051 Interfacing and Application Interfacing external peripherals to 8051 microcontroller like LCD,Keyboard,Stepper motor and DC motor.	3hrs
Chapter 7: Introduction to interrupts, interrupts vs polling classification of interrupts, interrupt priority, interrupt vector table interrupt service routine.	3 hrs

Text Book 1. " The 8051 Microcontroller Architecture, Programming & Applications " by ' Kenneth J. Ayala', Penram International, 1996 2. " The 8051 Microcontroller and Embedded systems ", by ' Muhammad Ali Mazidi and Janice GillispieMazidi', Pearson Education, 2003	
References 1. "Programming and Customizing the 8051 Microcontroller ", by 'Predko', TMH.	

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Program: III Semester Bachelor of Engineering (Biomedical Engineering)		
Laboratory Experiments		
Laboratory Title: C Programming (for Diploma)		**Lab. Code: 22EBMF204**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 52 Hrs	**Contact Hours: 4 Hrs/week**	**Credits: 0-0-2**

1. List of experiments/jobs planned to meet the requirements of the course.

Expt./Job No.	*Experiment/job Details*	*No. of Lab. Session/s per batch (estimate)*
1.	Write a C program to perform addition, subtraction, multiplication and division of two numbers.	*01*
2.	Write a C program to i) Identify greater number between two numbers using C program. ii) To check a given number is Even or Odd.	*01*
3.	Write a C program to i) To find the roots of a quadratic equation. ii) Find the factorial of given number.	*01*
4.	Write a C program to i) To find the sum of n natural numbers. ii) Print the sum of 1 + 3 + 5 + 7 + + n	*01*
5.	rite a C program to i) Print the pattern. * * * * * * * * * * * * * * * ii) Print the pattern 1 1 2 1 2 3 1 2 3 4 1 2 3 4 5	*01*
6.	Write a C program to To test whether the given character is Vowel or not. (using switch case)	*01*
7.	Write a C program to To accept 10 numbers and make the average of the numbers using one dimensional array.	*01*
8.	Write a C program to d out square of a number using function.	*01*
9	Write a C program to find the summation of three numbers using function.	*01*
10	Write a C program to Find out addition of two matrices.	*01*

1. ***Materials and Resources Required*:**

Text Book

1. Programming in ANSI C, E Balagurusamy

Course Content (4th Sem)

Course Code: 15EMAB208	Course Title: Linear Algebra and Partial Differential Equations	
L-T-P-SS: 4-0-0	Credits: 4	Contact Hrs: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Content	Hrs
Unit – 1	
Chapter No. 1. Matrices and Linear Equations Introduction, Geometry of Linear equations, Elementary operations, Systems in Echelon form, pivot and free variables, Gaussian elimination , Application to electrical circuits	06hrs
Chapter No. 2.Vector Spaces Vector Spaces and Subspaces, Solving AX=0 and AX=B, Linear combination of vectors, spanning set, Linear independence, Basis and Dimensions, Column space, Row space and Null space.	08 hrs
Chapter No. 3. Orthogonality Inner product spaces, Orthogonal and Ortho normal vectors, Gram-Schmidt process, QR-factorization; Eigen values and Eigen vectors, Diagonalizing matrices	06 hrs
Unit – 2	
Chapter No. 3.Partial differential equations Introduction, classification of PDE, Formation of PDE, Solution of equation of the type Pp + Qq = R, Solution of partial differential equation by direct integration methods, method of separation of variables. Modeling: Vibration of string-wave equation, heat equation. Laplace equation. Solution by method of separation of variables	10hrs
Chapter No. 4.Finite difference method Finite difference approximations to derivatives,finite difference solution of parabolic PDE explicit and implicit methods Hyperbolic PDE-explicit method, elliptic PDE-initial-boundary Value problems. Engineering Problems.	10hrs
Unit – 3	
Chapter No. 6.Complex analysis Function of complex variables. Limits, continuity and differentiability. Analytic functions, C-R equations in Cartesian and polar forms, construction of Analytic functions (Cartesian and polar forms).	05hrs
Chapter No. 7.Complex Integration Line integral, Cauchy's theorem- corollaries, Cauchy's Integral formula. Taylor's and Laurent Series, Singularities, Poles, Residue theorem – problems.	05 hrs
Text Book (List of books as mentioned in the approved syllabus) Gilbert Strang, Linear Algebra and its Applications, 4ed, Thomson India Edition, 2007. David C Lay, Linear Algebra and its Applications, 3ed, Pearson India, 2009 Peter v O'nell, Advanced Engineering Mathematics, Thomson-Books/Cole, Singapore Dennis G Zill and Michael R Cullin, Narosa publishing House , New Delhi, 2009	

References

Kreyszig E., Advanced Engineering Mathematics, 8ed, John Wiley & sons, 2003.
Schaum's Outline of Linear Algebra Seymour Lipschutz, Marc LipsonSastry 4ed, McGraw Hill India 2009
Stanely J Farlow, Partial differential equations for Scientists and Engineers, dover publications, INc, new York, 1993

Course Content

Program: IV Semester Bachelor of Engineering (Biomedical Engineering)		
Course Title: Signal Conditioning and Data Acquisition Circuits		**Course Code:22EBMC204**
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4Hrs/week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 50Hrs	**Examination Duration: 3 Hrs**	

Unit I	
Chapter No 1. Introduction to Operational Amplifiers: Basic differential amplifier, Introduction, Block schematic of an Op-amp, Characteristics of an Ideal OP-AMP, Circuit symbol and terminals, power supply connections, equivalent circuit of op-amp, open loop operation of op-amp, Feedback in ideal opamp: Inverting Amplifier, Non-inverting Amplifier, Voltage follower, Differential Amplifier, CMRR, PSRR.(relevant problems)	**8**
Chapter No 2. . Op-amp characteristics DC characteristics – Input bias current, Input offset current, Input offset voltage; Total output offset voltage, Thermal drift. AC characteristics – Frequency response, Slew rate,	**7**
Chapter No 3. Basic op-amp applications Scale changer/Inverter. Summing amplifier: Inverting summing amplifier Non-inverting Summing amplifier, Subtractor, Instrumentation Amplifier. (Relevant problems).	**5**
Unit II	
Chapter No 4. Linear applications of OPAMP V to I and I to V converters, Sample and hold circuit, Integrator, Differentiator, Active Filters –First and second order Low pass & High pass filters.	**10**
Chapter No 5. Nonlinear applications of OPAMP Comparators: Inverting comparator, non-inverting comparator, applications of comparator, Regenerative comparator (Schmitt Trigger), Astable and Monostable multivibrator, Triangular waveform generator. Oscillators: Phase shift oscillator, Wien bridge oscillator. (Relevant problems).	**10**
Unit III	
Chapter No 6. Data Acquisition Systems: Types of instrumentation systems, Components of Analog and Digital data acquisition system. **Data Converters** **Digital to Analog Converters:** Basic DAC techniques, Weighted Resistor R-2R DAC**Analog to Digital Converters:** Functional diagram of ADC, Flash ADC, Counter type ADC, Successive approximation ADC, Dual slope ADC, Pipeline ADC.DAC and ADC features/specifications.	**10**

Course Content

Course Code: 22EBMC205	Course Title: Biomedical Instrumentation	
L-T-P-Self Study: 4-0-0	Credits: 4	Contact Hrs: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter 1: Bioelectric Signals and Electrodes: Sources of Biomedical Signals, Origin of Bioelectric Signals, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes– Electrode-tissue interface, Electrolyte-Skin interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes.	10 hrs
Chapter 2: Pressure Measurement: Pressure Transducers-LVDT pressure transducers and Strain gauge pressure transducers. Physiological pressure ranges and measurement sites, Direct pressure measurement-catheters for pressure measurement, diaphragm displacement transducers, catheter tip pressure transducers, implantable pressure transducers and pressure telemetering capsules. Indirect pressure measurement-Indirect measurement of systolic, diastolic, and mean blood pressure, Detection of Kortokoff sounds.	10 hrs
Unit - 2	
Chapter 3: Temperature Measurement: Requirements for measurement ranges, Temperature transducers – Thermistors, thermocouples, wire and thin film thermoesistive elements, P-N junction diodes and transistors, infrared radiation thermometers, infrared thermography. Clinical thermometer probes, tympanic thermometers, telemetering capsules. Photoelectric Transducers: photovoltaic cells and photo emissive cells.	10 hrs
Chapter 4: Flow Measurement: Requirements for measurement ranges – blood flow in a single vessel, tissue blood flow, and respiratory gas flow. Electromagnetic flow meters – principle, methods of magnetic field excitation, perivascular probes, intravascular probes. Ultrasonic blood flow meters– propagation of ultrasound in the tissue, ultrasonic Doppler flow meters, blood flow measurement through Doppler imaging. Indicator dilution method – principle and working, thermo dilution method, Fick method, thermistor velocity probe, impedance cardiography	10 hrs
Unit - 3	
Chapter 5: Biomedical Recorders: Basic recording system, Biomedical signal analysis, Biomedical Recorders: Electrocardiograph, Phonocardiograph, Electroencephalograph, Electromyography, Digital recorders. Biosensors and Smart Sensors..	10 hrs
Text Books (List of books as mentioned in the approved syllabus) 1. Handbook of Biomedical Instrumentation- R S Khandpur, 2nd edition, Tata McGraw Hill, 2003 2. Biomedical Transducers and Instruments – Tatsuo Togawa, Toshiyo Tamura and P. Ake Oberg, CRC Press, 1997.	

References

1. Biomedical Instrumentation and Measurement – Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, 2nd Edition, Prentice-Hall India Pvt. Ltd., 2004.
2. Transducers and Instrumentation -D. V. S. Murty Prentice Hall India Pvt ltd. 2nd Edition

Course Content

Course Code: 22EBMC206	Course Title: Human Anatomy & Physiology	
L-T-P-Self Study: 4-0-0	Credits: 4	Contact Hrs: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter 1:Introduction: **Homeostasis, Tissue, Cartilage:** The internal environment and homeostasis, survival needs of the body, movement of substances within the body, body fluids, action potential, propagation of action potential, cell-structure and functions **Epithelial tissue**- simple epithelium, stratified epithelium, connective tissue- cells of connective tissue, loose connective tissue, Adipose tissue, Dense connective tissue, Lymphoid tissue, Cartilage- Hyaline cartilage, Fibrocartilage, Elastic cartilage	10hrs
Chapter 2: Nervous System: Functional Components of nervous system, Neurons: Properties of neurons, Cell bodies, Axon and Dendrites, Types of nerves, Synapse and neurotransmitters, neuromuscular junction. Central nervous system: Meninges, ventricles of the brain and CSF. **Brain:** Cerebrum, functions of cerebrum, functional areas of the cerebrum, Brainstem, Cerebellum, Spinal cord- grey matter, white matter, spinal reflex, Spinal nerves (in brief list & functions), Cranial nerves (in brief list & functions), Autonomic nervous system (in brief)- functions and effects. Pituitary gland and hypothalamus	10hrs
Unit - 2	
Chapter 3: Respiratory and Digestive System: Organs of respiration, Nose and Nasal cavity- position, structure and functions, pharynx -position, structure, functions. Larynx - position, structure and functions. Trachea, bronchi, bronchioles and alveoli, lungs- position, associated structure, pleura and pleural cavity. Respiration - muscles of respiration, cycle of respiration, variables affecting respiration, lung volumes and capacity **Organs of the digestive system** – mouth, tongue, teeth, salivary glands, pharynx, esophagus, stomach, gastric juice and functions of stomach, small intestine-structure, chemical digestion in small intestine, large intestine - structure, functions of the large intestine. Pancreas and Liver (only physiology)	10hrs
Chapter 4: Cardiovascular System: Introduction, Blood vessels- Arteries and Arterioles, Veins and Venules, capillaries, control of blood vessel diameter, blood supply- internal respiration, cell nutrition. Heart- position, structure pericardium, myocardium, endocardium, interior of the heart, flow of blood through the heart, blood supply to heart, Conducting system of the heart, factors affecting heart rate, the Cardiac cycle, cardiac output, blood pressure, control of blood pressure, pulse and factors affecting the pulse rate. Circulation of the blood- pulmonary circulation, systemic circulation-aorta (different parts of aorta & their blood supply, in brief). Summary of the main blood vessels (arteries & veins, explanation with flow diagram only)	10hrs
Unit - 3	
Chapter 5: Skeletal Systems Muscles and Joints: Bone, Types of bone, structure, bone cells, functions of bone. Axial skeleton- skull, sinuses, Fontanelles, vertebral column characteristics of typical vertebra, different parts of vertebral column (parts only), features of vertebral column, movements and functions of vertebral column, sternum, ribs, shoulder girdle and upper limb, pelvic girdle and lower limb. Skeletal muscle, Smooth muscle, Cardiac muscle, functions of muscle tissue, muscle tone and fatigue. Types of joint- Fibrous, Cartilaginous, Synovial, characteristics of synovial joints, shoulder joint, elbow joint, radio ulnar joint, wrist joint, Hip joint, Knee joint, ankle joint	10hrs

Text Books : 1. Ross & Wilson's Anatomy and Physiology in Health and Illness – by Anne Waugh and Allison Grant, 9th Edition, Churchill Livingstone Publications	
References 1. Concise Medical Physiology- by Sujit K. Chaudhuri, 5th Edition, New Central Book Agency Pvt. Ltd. 2. Essentials of Medical Physiology - by K. Sembulingam and PremaSembulingam, 3rd Edition, Jaypee Publications 3. Human Physiology: From Cells to Systems – by Lauralee Sherwood, 6th Edition, Thomson India Edition, 2007.	

Course Content

Course Title: ARM Processor & Applications	Course Code: 22EBMC207	
L-T-P: 3-0-0	Credits: 3	Contact Hours: 3 Hrs/week
ISA Marks: 50	ESA Marks: - 50	Total Marks: 100
Teaching Hours: 40Hrs	Examination Duration: 3 Hrs	

Content	Hrs
Unit – 1	
Chapter No. 1 ARM Architecture: The Acorn RISC machine, Architectural inheritance, ARM programmers model, ARM development tools, 3 stage pipeline ARM organization, ARM instruction execution. (text1 2.1, 2.2,2.3,2.4,2.4,4.1,4.3)	5hrs
Chapter No. 2 Introduction to ARM instruction set Data processing instructions, Data transfer instructions, control flow instructions, Simple assembly language programming. Branch instruction, Software interrupt instruction, multiply instructions , count loading zeros, Single word and unsigned byte data transfer instructions, Half-word and signed byte data transfer instructions, Multiple register transfer instructions, Swap memory and register instructions (SWP), Status register to general register transfer instructions Program status register instruction, Conditional execution, Example programs,Text1-3.1, 3.2, 3.3, 3.4, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14)	6 hrs
Chapter 3 Introduction to thumb instruction and implementation The Thumb programmer's model , Thumb branch instructions, Thumb software interrupt instruction, Thumb data processing instructions, Thumb single register data transfer instructions , Thumb multiple register data transfer instructions ,Thumb breakpoint instruction , Thumb implementation, Thumb applications. (Text1: 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 7.10)	4hr
Unit—2	
Chapter No. 4 Assembler rules and Directives Introduction, structure of assembly language modules, Predefined register names, frequently used directives, Macros, Miscellaneous assembler features. Example programs.(text2:4.1, 4.2, 4.3 4.4, 4.5, 4.6,)	5hrs
Chapter No.5 Exception handling Introduction, Interrupts, error conditions, processor exception sequence, the vector table, Exception handlers, Exception priorities, Procedures for handling exceptions.(text2:14.1 to 14.8)	5hrs
Chapter No. 6 Architectural support for high level languages Abstraction in software design, data types, floating point data types, The ARM floating point architecture, use of memory, run time environment.(text1:11.1 to 11.10)	5 hrs
Unit—3	
Chapter No. 7 On-chip programming techniques using LPC 2148 Controller ARM interfacing techniques and programming: Timers, RTC, UART, ADC, DAC, I2C and External Interrupt.	5 hrs
Chapter No. 8 LPC 2148 Controller Architectural overview and GPIO programming LPC2148 architectural overview, Registers,GPIO Programming: LED,LCD, Seven segment, Stepper Motor, DC Motor, Buzzer, Switch, Keypad.	5 hrs

Text Books: Steve Furber, ARM System- on-Chip Architecture, 2nd, LPE, 2002 William Hohl, ARM Assembly Language fundamentals and Techniques, 1st, CRC press, 2009.	
Reference Books: "ARM system Developer's Guide"- Hardbound, Publication date: 2004 Imprint: MORGAN KAUFFMAN	

Course Plan

Semester: 4th Semester Year:**2023-24 (Even)**

Laboratory Title: Signal Conditioning Circuits and Data Acquisition Lab	**Lab. Code: 22EBMP204**
Total Contact Hours: 42	**Duration of ESA Hours: 3 Hrs**
ISA Marks: 80	**ESA Marks: 20**
Lab. Plan Author: Mrs. S. R. Hiremath	**Date: 30-01-2024**
Checked By: Dr. Raviraj Havaldar	**Date: 01-02-2024**

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Exercise		**Total Weightage: 50.00**		**No. of lab sessions: 9.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1.	To measure the following parameters of op-amp: a)Input bias current b) Input offset voltage	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. Analyze DC characteristics of op-amp			**Op-amp characteristics**
2	Basic Op-amp circuits a) Inverting and Non Inverting Amplifier using OPAMP. b) Summer and Subtractor	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. Analyze basic op-amp circuits 2. Design adder and subtractor circuits for different input combinations			**Basic applications of op-amp**
3	Comparator: a) Voltage Comparator b) Zero crossing Detector	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. Analyze inverting and non-inverting voltage comparators 2. Analyze operation of zero crossing detector			**Nonlinear applications of OPAMP**

4	Precision rectifiers: Half-wave and Full wave rectifiers	1.00	5.00	
	Learning Outcomes: The students should be able to: 3. Verify the operation of precision rectifier circuits. 4. Plot the output waveforms			**Linear applications of OPAMP**
5	Realize and verify the performance of Instrumentation Amplifier using op-amp	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. Verify the performance of Instrumentation Amplifier. 2. Plot the frequency response			**Basic op-amp applications**
6	Realize and verify the performance of Integrators and Differentiators.	1.00	5.00	
	Learning Outcomes: The students should be able to: 1. Verify the performance of integrator and differentiator 2. Plot the output waveforms			**Linear applications of OPAMP**
7	Design and verify the performance of WeinBridge Oscillator using op-amp	1.00	5.00	
	Learning Outcomes: The students should be able to: 3. Design the wein bridge oscillator for the given specifications 4. Plot the output waveform			**Nonlinear applications of OPAMP**
8	Design and implement the filters for a given specifications: 2nd order Low pass and High pass filter	1.00	10.00	
	Learning Outcomes: The students should be able to: 3. Design 2nd order low-pass and high pass for the given cutoff frequency. 4. Plot the frequency response curve of the filter.			**Linear applications of OPAMP**
9	Realize 4 bit R-2R DAC using discrete components	1.00	5.00	Data Acquisition Systems and data Converters

Category: Demonstration		**Total Weightage: 10.00**		**No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
10	To realize 2-Bit flash ADC/4-Bit ADC (Using0804IC)	1.00	5.00	
	Learning Outcomes: The students should be able to: 1.Realize and verify the operation of analog to digital Converter 2.Analyze the performance parameters of the data converter			**Data Converters**
11	To realize wave shaping circuit using OPAMP.	1.00	5.00	
	Learning Outcomes: The students should be able to: 1.Realize and verify operation of clipping and clamping Circuits 2. Verify the output waveforms			**Non-linear applications of op-amp**
Category: Structured Enquiry		**Total Weightage: 20 .00**		**No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
12	Realize Sample and Hold circuit (using IC CD4066)	1.00	10.00	
	Learning Outcomes: The students should be able to: 3. Analyze the performance of sample and hold circuit. 4. Simulate the circuit using an IDE tool.			**Linear applications of OPAMP**
13	Square Wave generator (Astable Multivibrator) using 555 timer.	1.00	10.00	
	Learning Outcomes: The students should be able to: 1. Select the appropriate duty cycle and frequency 2. Simulate the circuit using an IDE tool.			**Nonlinear applications of OPAMP, Basic op-amp applications**

	***Materials and Resources Required*:** **Text Books:** 1. Linear Integrated Circuits, D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2010, New Age International. 2. Op - Amps and Linear Integrated Circuits, Ramakant A. Gayakwad, 4th edition, PHI.	
	References: 1. A course in Electrical & Electronic Measurements & Instrumentation, A K Sawhney, Dhanpat Rai Publications, 19th edition, 2011. 2. Operational Amplifiers and Linear Integrated Circuits, Robert. F. Coughlin & Fred. F. Driscoll, PHI/Pearson, 2006 3. Op - Amps and Linear Integrated Circuits, James M. Fiore, Thomson Learning, 2001 4. Design with Operational Amplifiers and Analog Integrated Circuits, Sergio Franco, TMH,	

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CourseCode: 22EBMF205	Course Title: Data Structure Using C Lab(Diploma)	
L-T-P: 1-0-2	Credits:3	Contact Hrs: 6 hrs/week
ISAMarks:80	ESAMarks:20	Total Marks: 100
Teaching Hrs: 72	Semester : IV	Exam Duration: 2hrs

Content	Slots
Chapter No.1: Arrays , Strings and Pointers Introduction, Declaration, Accessing elements, Storing values in arrays,Operations on one dimensional array, Operations on two dimensional arrays. **Pointers: I**ntroduction, declaring pointer, pointer variables, pointer expression and arithmetic, passing arguments to functions using pointers, pointers and arrays, Passing an array to a function. **Strings:** string handling functions.	**10**
Chapter No.2: Structures and Unions Introduction, passing structures to functions, Array of structures, Unions.	**4**
Chapter No.3: Introduction to Data structures Data structure Operations, Dynamic Memory Allocation Functions, Files – File manipulation programs.	**4**
Chapter no.4: Stacks and Queues Stack: Definition, Operations, Stack ADT Implementation of stack operations. Polish notation: Infix to postfix conversion, evaluation of postfix expression, parenthesis matching and other applications Queue: Definitions, Queue ADT, Variants of Queues: Linear queue, circular queue, priority queue, double ended queue and multiple queues.	**6**
Chapter no.5: Link list and Trees Abstract data type, Definition, Representation of linked lists in Memory, Operations: Traversing, Searching, Insertion and Deletion., Doubly Linked lists, Circular linked lists Applications of Linked lists – Polynomials, Sparse matrix representation and other application. **Binary Tree**: Definition, Terminology and representation, Tree Traversals both recursive and 4 Iterative. Binary Search Tree. **Sorting**: Bubble sort, Merge sort, Quick sort.	**6**

Text Books:

1. DataStructuresUsingCandC++-Y.Langsam,M.AugensteinAndA.M.Tenenbaum,Prentice-HallofIndiaPvt.Ltd.Edition-2,2006
2. Data Structures with C--Seymour Lipschutz,Tata Mc GrawHill IndiaLTD,EdItion-1,2011

References:

1. Data Structures and Algorithms Made Easy – Narshiman Karumunchi, Career Monk Publications, Edition-2,2017.
2. DataStructure Through C- Yashavant P Kanetkar, BPB Publication,Edition-3.
3. Problem Solving in Data structures and Algorithms Using C – Hemant Jain, Taran Technologies PrivateLimited,Edition-1,2016
4. Introduction to Algorithms - Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.TheMITPress,Edition-3,2009.
5. Cracking thecodinginterview-GayleMcDowell,Edition-6
6. Onlineplatform:www.Hackerrank.com,www.geeksforgeeks.com

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Experiment wise plan

1. List of experiments/jobs planned to meet the requirements of the course.

Category: Experiments	**Total Weightage: 100**	**No. of Lab sessions: 12**

Learning Outcomes :
The students should be able to:

1. Write a modular C program for a given problem using structures and pointers.
2. Write an ADT for lists, stack, queue and trees.
3. Apply list operations for a given problem
4. Apply stack operations for a given problem.
5. Apply queue operations for a given problem.
6. Write modular programs for tree traversals
7. Write programs using online coding platforms.

Exp. No	**Experiment Details**	**No. of Lab. Session**	**Marks/Experiment**	**Correlation of Experiment with the theory**	**CO**	**PO**	**PI**
1	Advanced C concepts	2	08	Arrays, Strings and Pointers	**1,3**	**2**	**2.1.3**
2	Introduction to Structures &Pointers, Data Structures operations, Dynamic memory allocation, functions File Handling Recursion	2	12	Structures and Pointers	1,3	2	2.1.3
3	Minor Exam I	01	15	Structure, Files and Pointers, Linked List	1,2,3	2	2.1.3
4	Definition of Stack, Abstract Data type Implementation of stack operations Application of stack. Definition of Queues, Queues ADT, Variants of Queue: Linear queue, circular queue	2	10	Stacks and Queues	1,2,3	1,2	1.3.6, 2.1.3

4	Introduction to lists Representation of linked list in memory, List Operations: Traversing, Searching, Insertion and deletion, Doubly linked list, circular linked list, Applications of Linked list	2	10	Lists	1,2,3	1,2	1.3.6, 2.1.3
5	Minor Exam II	01	15	Stacks, Queues and Linked List	1,2,3	2	2.1.3
6	Introduction to Binary trees, Terminology and representation, Tree traversals	2	10	Binary Tree	1,2,3	1,2	1.3.6, 2.1.3

Course Content

Course Code: 15EMAB242	Course Title: Vector Calculus and Differential equations	
L-T-P-SS: 4-0-0-0	Credits: 4	Contact Hrs: 4
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50		Exam Duration: 3 hrs

Content	Hrs
Unit – 1	
Chapter No. 1 Partial differentiation Function of several variables, Partial derivatives, Chain rule, Errors and approximations	7hrs
Chapter No. 2 Multiple integrals Double integral, Evaluation by change of order, change of variables, simple problems, Triple integrals simple problems	7hrs
Chapter No. 3 Vector Algebra Vector addition, multiplication (Dot and Cross products), Triple products,	6hrs
Unit – 2	
Chapter No. 4Vector Calculus Vector functions, Vector differentiation, Velocity and Acceleration of a vector point function, Vector fields, Gradient and directional derivatives. Line and Surface integrals. Independence of path and potential functions. Green's theorem, Divergence of vector field, Divergence theorem, Curl of vector field. Stokes theorem.	20hrs
Unit – 3	
Chapter No. 5Partial differential equations (a) Introduction, classification of PDE, Formation of PDE, Solution of equation of the type Pp + Qq = R, Solution of partial differential equation by direct integration methods, method of separation of variables. (b) Modeling: Vibration of one-dimensional string-wave equation and heat equation. Laplace equation. solution by method of separation of variables	10hrs

Text Book (List of books as mentioned in the approved syllabus)

1. Kreyszig E., Advanced Engineering Mathematics, 8ed, John Wiley & sons, 2003.
2. Bali and Iyengar, A text book of Engineering Mathematics, 6ed, Laxmi Publications(p) Ltd, New Delhi,2003Early Transcendental Calculus James Stewart, Thomson Book's 5e 2007

Reference Books:

1. Early Transcendentals Calculus- James Stewart, Thomson Books, 5e 2007

Grewal B S, Higher Engineering Mathematics, 38ed, Khanna Publication, New Delhi, 2001

Course Content (5th Sem)

Course Code: 22EBMC301	Course Title: Fundamentals of Signals & DSP	
L-T-P : 4-0-0	Credits: 4	Contact Hrs: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 4		Exam Duration: 3 hours

Content	Hrs
Unit - 1	
Introduction to Signals and Systems: Basic elements of a DSP System, Classification of Signals, Sampling Theorem (statement and problems on Nyquist rate), Discrete Time Signals (Representation, Standard Signals, Classification, and Operations), Discrete Time Systems, Convolution Sum, Cross correlation and Auto correlation of sequences	**10 hrs**
Z- Transform and its Application to analysis of LTI Systems: Direct Z-Transform, Properties of the Z-Transform, Examples, Inverse Z- Transform by Partial-Fraction Expansion method only, System Function of a LTI System, Causality and Stability (from H (z)). Realization of Digital System: Direct Form I, Direct form II, cascade form and parallel form	**10 hrs**
Unit - 2	
DFT: Properties and Applications: Definition and Problems on DFT&IDFT, DFT Properties – Periodicity, Linearity, Time Reversal, Circular Time Shift, Circular Frequency Shift, Circular Convolution, Multiplication of two DFTs& Circular Convolution, Parseval's Theorem, DFT in linear filtering. Introduction to FFT, 8-point DFT Computation using Radix-2 DIT-FFT&DIF-FFT methods only, relevant examples.	**10 hrs**
IIR& FIR Filters: IIR Filters: Low-pass filter specifications, IIR filter Design by Impulse Invariance & Bilinear Techniques, Design of Digital IIR filter by Butterworth approach, Examples. Magnitude response of low pass Chebyshev Type I, II filter (Theoretical concept only) FIR Filters: Design of FIR filters – Symmetric and Anti symmetric FIR filters, Design of Linear phase FIR filters by Rectangular Hamming & Hanning windows. Summary of window function characteristics (window shape, transition bandwidth, stop band attenuation, etc.). Implementation of FIR filters by direct form and Single-stage lattice structure only.	**10 hrs**
Unit - 3	
Multirate Digital Signal Processing & Adaptive Filters: Introduction, Decimation Process, Interpolation Process, Digital Filter Bank, Adaptive Filters, LMS adaptive algorithm, Applications, Features & Architectural of TMS320C54XX processor.	**10 hrs**

Text Books

1. Dimitris G Manolakis, John G. Proakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, 4th Edition, Pearson India, 2007.
2. V.Udayashankara, “Modern Digital Signal Processing”, Third Edition, PHI 2016

Reference Books:

3. Simon Haykin and Barry Van Veen “Signals and Systems”, John Wiley & Sons, 2nd edition.
4. S K Mitra, “Digital Signal Processing”, 4th Edition, McGraw-Hill.
5. Avtar Singh, “Digital Signal Processing Implementation”, Brooks Cole.

Course Content

Course Code: **22EBMC302**	Course Title: **Clinical Instrumentation**	
L-T-P : 4-0-0	Credits: 4	Contact Hrs: 4
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50Hrs		Exam Duration: 3 Hrs

Content	**Hrs**
Unit - 1	
Chapter 1. **Orthopaedics Instruments:** Microstructure of bone, Cartilages, Bones and joints, Fractures and its types, POP Plastering, Bone screws, bone plates, wires. Properties of metal components used in fractures. Wound healing process. Osteotomes, Bone Cutting Forceps, Gigli Saws, Plate Benders	10 hours
Chapter 2. **Cardiology:** Catheterization Laboratory Instrumentation, Arrhythmia monitor, Exercise stress testing, Ambulatory monitoring instruments Foetal Monitoring Instruments: Cardiotocograph, Abdominal Foetal Electrocardiogram, Foetal Phonocardiogram Oximeters: Oximetry, Ear Oximeter, Pulse Oximeter, Skin reflectance Oximeters, Intravascular Oximeter	10 hours
Unit - 2	
Chapter 3. **Opthalmology:** Anatomy of human eye, Physiology of vision, Errors of refraction and their optical correction, Aqueous humor production and drainage, Strabismus. Clinical methods: Spectacles and contact lenses, Refractive surgery, Snellen‟s Chart, Cover – uncover test, Maddox rod test, Maddox wing test.	10 hours
Chapter 4. **Opthalmology Instruments:** Tonometry and its types, Perimetry - Peripheral Field Charting, Central Field Charting, Fundus Fluorescein Angiography, Electroretinography, Electro-oculography, Loupe & Lens Examination, Slit-Lamp Examination, Gonioscopy, Retinoscope-Principle, Procedure & Types, Refractometry, Keratometry- principle and types, subjective refraction, Ophthalmoscopy-Direct & Indirect	10 hours
Unit - 3	
Chapter 5 **Opthalmology Surgical Instruments:** Cataract – list of classification only, Surgical techniques for cataract extraction – Intracapsular cataract extraction & Extracapsular cataract extraction for adulthood cataract, Phacoemulsification, Intraocular lens implantation. General considerations of Glaucoma, surgical procedures for Glaucoma, Vitreous Liquefaction, Vitreous Opacities, Vitreous Haemorrhage, Vitrectomy-types and techniques, Lasers in Ophthalmology, Cryotherapy in Ophthalmology	10 hours

Text Books:

“Textbook of Medical Physiology”, Guyton & Hall, 11th Edition, Reed Elsevier Pvt. Ltd., 2007.
“Handbook of Biomedical Instrumentation”, R S Khandpur, 2nd edition, McGrawHill Education, 2013.
“Comprehensive Ophthalmology”, A. K. Khurana, 4th Edition, New Age International Ltd., 2010
“Clinical Fracture Management”, G R Baldwin, 3rd edition, McGrawHill Education, 2016.

Course Content

Course Code: 22EBMC303	Course Title:Therapeutic Devices and Circuits	
L-T-P : 4-0-0	Credits: 4	Contact Hrs: 4
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50Hrs		Exam Duration: 3 Hrs

Content	Hrs
Unit - 1	
Chapter 1. Cardiac pace makers: Need for Cardiac pace maker. Types of pace makers:-external and Implantable pacemakers. Classification codes for Pacemakers. Ventricular synchronous demand pacemaker, Programmable pacemaker. Power sources for Implantable pacemakers. Cardiac defibrillators: Need for defibrillator. DC defibrillator. Pacer-Cardioverter-defibrillator. Defibrilatoranalyser. Principle of surgical diathermy. Solid state electrosurgical	10 hours
Chapter 2. Laser and its applications in biomedical: Fundamentals of Laser, Pulsed Ruby Laser, Nd-YAG Laser, Helium-Neon Laser, Argon Laser, Carbon dioxide lasers, Excimer Laser, Semiconductor Laser safety. Electrotherapy Equipment's: High frequency heat therapy, Shortwave diathermy, Microwave diathermy, Electro diagnostic and Therapeutic apparatus.	10 hours
Unit - 2	
Chapter 3. Hemodialysis Machine: Function of the Kidneys. Changes in body fluids in renal disease. Artificial Kidney. Dialyzers: Parallel flow, coil, Hallow fibre type dialyzers. Performance analysis of dialyzers. Hemodialysis machine. Heart lung machine (Cardiac assist device), Lithotriptor machine, Extra-corporeal shock-wave therapy, Infant incubator.Anaesthesia machine	10 hours
Chapter 4. Ventilators: Types of ventilators, Classification, Pressure-volume-flow, High frequency ventilators, Humidifiers, Nebulizers and Aspirators. Automated Drug Delivery system: Infusion pump, Components of drug infusion systems, Implantable infusion system, Closed-loop control in infusion system Laser and its applications in biomedical	10 hours
Unit - 3	
Chapter 5 Introduction to man-Instrument system. Components of Man-Instrument system. Problems encountered in measuring a living system. Physiological effects of Electrical current. Shock Hazards from Electrical equipment"s. Methods of accident prevention. Precautions to minimize Electric shock hazards. Safety codes for Electromedical equipment. Electrical safety analyser.	10 hours

Text Books:

"Handbook of Biomedical Instrumentation", R S Khandpur, 2nd edition, McGrawHill Education, 2013
"Medical Instrumentation, Application and Design", John G. Webster, 3rd Edition, John Wiley & Sons
"Biomedical Instrumentation and Measurements", Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, 2nd Edition, Prentice Hall of India Private Limited, 2001
"Introduction to Biomedical Equipment Technology", Joseph J Carr, John M. Brown, 4th Edition, Pearson Education, 2004.

Course Content

Course Code: 22EBMC304	Course Title: Operating System and Embedded Systems Design	
L-T-P-Self Study: 3-0-0-0	Credits: 3	Contact Hrs: 40
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter No 1. Introduction to Operating System What is an operating system? Goals of an operating system. Operation of an OS. Operating System Services. System Calls and Types. Operating system Structure – Simple, Layered, Microkernels, Modules and Hybrid Systems. System Boot	3 hrs
Chapter No 2. Process Management Process concept- operating on the process, inter-process communication, process scheduling-CPU scheduler-preemptive scheduling, scheduling criteria, scheduling algorithms- first come, first served scheduling, shortest Job first scheduling, priority scheduling, round robin scheduling	5 hrs
Chapter No 3. Memory Management Memory Management Strategies: process address space static vs dynamic loading. Swapping, memory allocation; fragmentation, Paging, Segmentation and Virtual Memory.	6 hrs
Unit - 2	
Chapter No 4. Introduction To Real-Time Operating Systems Introduction To Real-Time Operating Systems: Introduction to OS, Introduction to the real- time embedded system- real-time systems, characteristics of real-time systems and the future of embedded systems. Introduction to RTOS, key characteristics of RTOS, its kernel, components in RTOS kernel, Scheduling types: Preemptive priority-based scheduling, Round-robin and preemptive scheduling	8 hrs
Chapter No 5. Tasks, Semaphores and Message Queues: Task: Structure, Event Flags: Structure, uses, Semaphore: Structure, Types: binary semaphore, mutual exclusion (mutex) semaphore, and Uses. Message Queue: Structure, Uses. Priority Inversion problem and its solutions.	8 hrs
Unit - 3	
Chapter No 6. Typical Embedded System and bus protocols:: Classification and purposes of embedded system, Characters and Quality attributes of embedded system, Core and Supporting components of embedded system, AMBA Bus Protocol, SPI, RS 485, wireless protocols (Bluetooth, 802.11 and its variants, ZigBee)	08 hrs
Chapter 7: Case study: Applications based on Cortex M series in RTOS environment	02 hrs

Text Books (List of books as mentioned in the approved syllabus)

1. Silberschatz ,Galvin and Gagne , Operating system concepts, 8, WILEY Publication
2. Qing Li with Caroline Yao, Real-Time Concepts for Embedded Systems, 1, 2011
3. Shibu K V, Introduction to Embedded systems, 6, 2012
4. Raj Kamal, Embedded Systems, McGraw-Hill

References

1. Dhananjay Dhamdhere, Operating Systems a Concept-Based Approach, 2, McGraw-Hill

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Exercise		**Total Weightage: 50.00**		**No. of lab sessions: 12.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1.	Processing and analysis of ECG/EEG/EMG.	1.00	5.00	**Cardiology**
	Learning Outcomes: The students should be able to: 2. Analyze the signals and compare with the normal signals			
2	Study of respiratory ratemeter and apnea monitor.	1.00	3.00	**Respiratory devices**
	Learning Outcomes: The students should be able to: 1. Indicate the normal and abnormal respiratory rates.			
3	Study of the diathermy unit (Unipolar and Bipolar)	1.00	3.00	**Surgical devices**
	Learning Outcomes: The students should be able to: 1. Explain the working of diathermy unit and analyse the necessity of unipolar or bipolar electrodes.			

4	Study of Ultrasound Doppler/Fetal monitor and study different modes of ultrasonic devices.	1.00	3.00	**Cardiology**
	Learning Outcomes: The students should be able to: 1. Monitor the uterine contractions and fetal heart rate. 2. Explain the applications of various modes of ultrasound.			
5	Study of the cardiac catheterization lab, Holter monitoring	1.00	3.00	**Cardiology**
	Learning Outcomes: The students should be able to: 3. Describe the facilities provides in the cath lab 4. Explain the importance of holter monitoring and the various parameters observed.			
6	Study of the fracture treatment and the orthopedic implants	1.00	3.00	**Orthopaedics Instruments**
	Learning Outcomes: The students should be able to: 1. Explain the direct and indirect methods of fracture treatment 2. Identify the different types of implants used as a rehabilitative approach			
7	Study of C-ARM, X-Ray radiography, CT and MRI	1.00	5.00	**Imaging modalities**
	Learning Outcomes: The students should be able to: 1. Indicate and differentiate the working principles and applications of various imaging modalities required in the diagnosis of any disease.			
8	Testing and analysis of the following by hardware circuit/simulation (i) DC Defibrillator (ii) Pacemaker	1.00	5.00	**Cardiology**
	Learning Outcomes: The students should be able to: 1. Analyse the ECG signal and identify the need of a pacemaker or a defibrillator.			
9	Acquisition of ECG: (i) Single lead (iii) Three lead, and (iii) 12-Leads	1.00	5.00	**Cardiology**

	Learning Outcomes: The students should be able to: 1. Acquire the ECG signal from a subject using different lead configurations			
10	Analysis of the acquired ECG and EEG in amplitude, time and frequency domain	1.00	5.00	**Cardiology**
	Learning Outcomes: The students should be able to: 1. Analyse the ECG & EEG signal with respect to amplitude , time and frequency			
11	Acquisition and analysis of Lung Volumes and Lung Capacities using Spirometer	1.00	5.00	**Respiratory devices**
	Learning Outcomes: The students should be able to: 1. Acquire the respiratory signals and analyse the lung volume and its capacity along with various parameters.			
12	Quantification and assessment of hearing ability using audiometer	1.00	5.00	**Diagnostic devices**
	Learning Outcomes: The students should be able to: 1. Record the audio signals and test the hearing capacity of the subject and identify the mode of deafness.			
Category: Demonstration		**Total Weightage: 10.00**		**No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
13	Measurement of corneal curvature using keratometer, and Measurement of Visual Acuity using Snell‟s Chart	1.00	5.00	**Ophthalmology Instruments**
	Learning Outcomes: The students should be able to: 1. Measure the visual acuity and the corneal curvature of the eye to identify the refractive error.			
14	Study Experiments: Baby incubator, Ventilator, Heart-lung machine, Dialysis machine, Pacemaker, Ophthalmoscope, Pulse Oximeter, and Infusion	1.00	5.00	**Diagnostic & Therapeutic devices**

	Pump.			
	Learning Outcomes: The students should be able to: 1. Demonstrate the working of the various equipment's.			
Category: Structured Enquiry		**Total Weightage: 20 .00**		**No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
15	Design a pulse generating circuit and control the pacing pulses.	1.00	10.00	**Cardiology**
	Learning Outcomes: The students should be able to: 1. Analyze whether the pulse rate is normal or abnormal			
16	Design a defibrillator circuit using capacitors and transformers.	1.00	10.00	**Cardiology**
	Learning Outcomes: The students should be able to: 1. Select the appropriate capacitance charging and discharging values			

Experiment Wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Demonstration		**Total Weightage: 0**		**No. of lab sessions: 1.00**
Expt./ Job No.	**Experiment / Job Details**	**Correlation of Experiment with the theory**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Write an optimized C program to Create Tasks using RTX Kernel. Also, comment on the Performance.	1.00	0.00	Introduction to RTX
	Learning Outcomes: **The students should be able to:** 1. Demonstrate the knowledge of software development through basic programming skills using C and perform basic andadvanced Timer Operation			

Category: Exercise		**Total Weightage: 40.00**		**No. of lab sessions: 7.00**
Exp No	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Write an optimized C program to Create Tasks using RTX Kernel. Also, comment on the performance.	1.00	0.00	Introduction to RTX
	Learning Outcomes: **The students should be able to:** 1. Demonstrate the knowledge of software development through basic programming skills using C and perform basic and advanced Timer Operation			
2	Write an optimized RTOS program & demonstrate the concept of Round Robin Task Scheduling, and comment on performance.	1.00	5.00	Process management, Introduction to RTOS
	Learning Outcomes: **The students should be able to:** 1. Demonstrate the algorithms of RTOS through basic and peripheral interfacing programming skills using C and RTX Kernel.			
3	Write an optimized RTOS program to demonstrate the concept of basic preemptive scheduling algorithm using RTX	1.00	5.00	Process management, Introduction to
	Kernel and comment on performance.			RTOS

	Learning Outcomes: **The students should be able to:** 1. Demonstrate the knowledge of software development through basic programming skills using C and perform basic and advanced peripheral interfacing			
4	Write an optimized RTOS program & demonstrate the concept of Events and Flags for inter-task communication using RTX Kernel. Also, comment on Performance.	1.00	10.00	Event Flags
	Learning Outcomes: **The students should be able to:** 1. Demonstrate the knowledge of software development through basic programming skills using C and execute basic concepts of Real-time operating systems.			
5	Write an optimized RTOS program & demonstrate the concept of Mailbox, and Comment on performance.	1.00	10.00	Mailbox
	Learning Outcomes: **The students should be able to:** 1. Demonstrate the knowledge of software development through basic programming skills using C and execute basic concepts of Real-time operating systems.			
6	Write an optimized RTOS program & Demonstrate the concept of Semaphore, and comment on performance.	1.00	10.00	Semaphores
	Learning Outcomes: **The students should be able to:** 1. Demonstrate the knowledge of software development through basic programming skills using C and execute basic concepts of Real-time operating systems.			
7	Write an optimized 'C' program & Demonstrate the concept of software Interrupts. Also comment on performance.	1.00	10.00	Introduction

	Learning Outcomes: **The students should be able to:** Demonstrate the knowledge of software development through basic programming skills using C and execute basic concepts of Real-time operating systems.			
Category: Structured Enquiry		**Total Weight age: 10.00**		**No. of lab sessions: 1.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Write an optimized 'C' program to interface SPI-EEPROM with LPC2148 and comment on performance.	1.00	10	Protocols
	Learning Outcomes: **The students should be able to:** 1. Demonstrate the knowledge of interfacing the microcontroller usingthe serial peripheral interface.			
Category: Open Ended		**Total Weight age: 30.00**		**No. of lab sessions: 3.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s)per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Develop an RTOS application for the Given Problem	1.00	20.00	RTOS and LPC2148
	Learning Outcomes: **The students should be able to:** 1. Demonstrate proficiency in developing a real time system.			

1. **Books/References:**
   i. "ARM System-on-Chip Architecture" by 'Steve Furber", LPE, Second Edition.
   ii. "ARM Assembly Language fundamentals and Techniques" by William Hohl, CRC press, 2009.
   iii. "ARM system Developer's Guide"- Hardbound, Publication date: 2004Imprint: MORGAN KAUFFMAN.
2. **Manuals:**
   i. LPC2148Datasheet.
   ii. RTX User guide
   iii. LPC2148 manual.
3. **Evaluation:**

Students Assessment through ISA (80%) + ESA (20%)

Laboratory Plan

Semester: **5 - Semester**	Year:
Laboratory Title: Mini Project	**Lab. Code: 23EBMW301**
Total Contact Credits: 60	**Duration of ESA: 3 Hours**
ESA Marks: 50	**ISA Marks: 50**
Lab. Plan Author: UjwalaPatil, S. R. Hiremath	**Date: 10-10-2024**
Checked By: Dr.Nalini C Iyer, Dr. R. H. Havaldar	**Date: 10-10-2024**

***Prerequisites*:**
This mini project requires the student to have knowledge of courses like engineering physics, mathematics, analog electronics, signals and systems, HDL, communication and programming concepts up to IV semester level.

Theme:
Theme of the mini project is decided based on the courses that students have taken till IV sem. Focus includes improving programming skills likeC/C++/java/HDL and system level thinking**.** Students also need to build GUI for the selected project.

Course Outcomes (COs):

At the end of the course the student should be able to:

1. Analyze and record the requirements for the identified problem
2. Generate the design alternatives to meet desired functionality
3. Select the optimal design for further development
4. Transform the fundamental knowledge gained in the curriculum to Model / Design / Develop prototype / system for component / system to meet the identified Requirements.
5. Develop technical writing skills and presentation skills
   Work in a team to meet project requirements

Course Content (6th Sem)

Course Code: 22EBMC306	Course Title: Biomedical Digital Signal Processing	
L-T-P-Self Study: 3-0-0-0	Credits: 3	Contact Hrs: 40
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Unit - 1	
Chapter 1: Introduction The nature of biomedical signals, objectives of biomedical signal analysis, difficulties encountered in biomedical signal analysis, Computer aided diagnosis. **Neurological Signal processing:** Electrophysiological origin of Brain waves EEG signal and its characteristics, EEG analysis, Linear prediction theory, Autoregressive (AR) method, Recursive Estimation of AR parameters, Spectral error measure, Adaptive segmentation	10 hours
Chapter 2: Signal averaging Basics of signal averaging, Signal averaging as a digital filter, A typical average, Software for signal averaging, Limitations of signal averaging. Data Acquisition and classification of sleep stages, The Markov model and Markov chains, Dynamics of Sleep-wake Transitions, Hypnogram Model Parameters.	6hours
Unit - 2	
Chapter 3: Filtering for Artifacts Removal :Random noise, structured noise and physiological interference, stationary versus non-stationary processes, time domain filters with application: Synchronized averaging, moving-average filters Frequency domain filters with examples, removal of high frequency noise by Butterworth low pass filters, removal of low frequency noise by Butterworth high pass filter, removal of periodic artifacts by notch and comb filters.	10 hours
Chapter 4: **ECG Parameters and their estimation**: QRS detection techniques, Estimation of ST-segment. A review of wiener filtering problem, Principle of an adaptive filter, Adoptive noise canceller, Cancellation 60Hz Interference in ECG, Cancelling Donor heart Interference in Heart-transplant ECG, Cancelling of maternal ECG in Fetal ECG.	8 hours

Unit - 3	
Chapter 5: Data Reduction Direct ECG data compression techniques: TP, AZTECH, CORTES, Other data compression techniques: DPCM, Entropy coding, Peak-picking compression, Cycle-to-Cycle compression, Data compression techniques comparison.	6 hours

Text Books (List of books as mentioned in the approved syllabus)

1. Biomedical signal analysis- A case study approach, Rangayyan Rangaraj, Wiley (IEEE Press)-2005
2. Biomedical Signal Processing- Principles and Techniques - D.C.Reddy, Tata McGraw-Hill, 2005.
3. Biomedical Digital Signal Processing-Willis J.Tompkins, PHI, 2000.

References

1. Biomedical Signal Processing and Signal Modeling by Eugene N Bruce, John Wiley & Son's publication
2. Biomedical Engineering and Design Handbook by Myer Kutz, McGraw Hill

Course Content

Course Code: 22EBMC305	**Course Title: Medical Image Processing**	
L-T-P-Self Study: 3-0-0	**Credits: 3**	**Contact Hrs: 40**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hrs: 40		**Exam Duration: 3 hrs**

Content	**Hrs**
Unit - 1	
Chapter 1. **Introduction**: Background, Examples of fields that use DIP, Fundamental steps in Digital Image Processing (DIP), Components of DIP system, Image sensing and acquisition, A simple image formation model, Image sampling and quantization. Basic relationship between pixels.	7 hrs.
Chapter2. **Image Enhancement in Spatial Domain**: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Intensity level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram matching (specification), Arithmetic/Logic operations – Image subtraction, Image averaging. Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters	7 hrs.
Unit - 2	
Chapter 3. **Image Enhancement In Frequency Domain:** Background, 2D-Discrete Fourier Transform and its Inverse, Basic properties of the 2D-Discrete Fourier Transform, Basics of filtering in the frequency domain. .	7 hrs.
Chapter 4. **Image smoothing using frequency domain filters** – Ideal low pass filters, Butterworth low pass filters, Gaussian low pass filters; Image sharpening using frequency domain filters – Ideal high pass filters, Butterworth high pass filters, Gaussian high pass filters, Homomorphic filtering	7 hrs.
Unit - 3	
Chapter 5. **Image Segmentation**: Fundamentals, Point detection, Line detection, Edge models, Edge detection, Thresholding, Region based segmentation.	6 hrs.
Chapter 6. **Image Compression**: Fundamentals, Image compression models, Basic compression methods – Huffman coding, Arithmetic coding, LZW coding, Run-length coding.	06 hrs

Text Book (List of books as mentioned in the approved syllabus) Digital Image Processing - Rafael. C. Gonzalez and Richard. E. Woods, Third Edition, Pearson Education, 2008.
Reference Books: 1. Fundamentals of Digital Image Processing - Anil K. Jain, 5th Indian Print, PHI, 2002. 2. Digital Image Processing and Computer Vision - Milan Sonka, India Edition, Cengage Learning

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Course Plan

Program: 6 semester Bachelor of Engineering (Biomedical Engineering)		
Course Title: Introduction to Python Programming	**Course Code: 22EBME314**	
L-T-P: 3-0-0	**Credits: 3**	**Tutorial/Project: 3Hrs/ Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hrs.: 40		**Exam Duration: 3 hours**

Content	**Hrs**
Unit – 1	
Chapter No.1 Introduction Python Basics Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program.**(Textbook 1: Chapters 1)**	7
Chapter No. 2 Flow control Boolean Values, Comparison Operators, Boolean Operators , Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules,Ending a Program Early with sys.exit(). **(Textbook 1: Chapters 2)**	7
Unit – 2	
Chapter No. 3 Functions and Lists: **Functions:** def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling, A Short Program: Guess the Number. **(Textbook 1: Chapters 3)** **Lists :**The List Data Type, Working with Lists, Augmented Assignment Operators, Methods, Example Programs, List-like Types: Strings and Tuples, References. **(Textbook 1: Chapters 4)**	7
Chapter 5 : Dictionaries and Strings **Dictionaries and Structuring Data:** The Dictionary Data Type, Using Data Structures to Model Real-World Things.**(Textbook 1: Chapters 5)** **Manipulating Strings:** Working with Strings, Useful String Methods, Project: Password Locker, Project: Adding Bullets to Wiki Mark-up **(Textbook 1: Chapters 6)**	7
Unit –3	
Chapter 6: Python packages: Understanding Python built in packages: Numpy, matplotlib, Scipy, Pandas, SK learn and it's Applications. **Debugging**: Raising Exceptions, Getting the Traceback as a String, Assertions, Logging, IDLE"s Debugger. (**Textbook 1: Chapters 10)**	7
Chapter 7: Classes and Objects:	

Need for object oriented programming, Characteristics of OOPS, Specifying the class, Defining objects and classes, calling members functions, objects as data types Functions: Functions Declaration, Calling the function, function definition, Passing Arguments to functions. **(Textbook 3)**	5

Text Books

1. Al Sweigart, "Automate the Boring Stuff with Python", 1stEdition, No Starch Press, 2015.

2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition.

3. Object oriented programming in TURBO C++ - Robert Lafore, Galgotia Publications, 2002.

Reference books:

1. Python for Data Analysis Data Wrangling with pandas, NumPy & Jupyter, Wes McKinney,3rd edition.

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Course Content

Program: VI semester Bachelor of Engineering (Biomedical Engineering)		
Course Title: Machine Learning	**Course Code: 22EBMF301**	
L-T-P: 2-0-1	**Credits: 3**	**Tutorial/Project: 2Hrs/ Week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hrs.: 30		**Exam Duration: 2 hours**

Content	**Hrs**
Unit - 1	
Chapter No.1 Introduction Motivation, History and Evolution, Definition (ETP, Examples), Types of Machine Learning: Supervised, Unsupervised and Reinforcement learning.	03
Chapter No. 2 Supervised Learning **Model Representation**: Basic Terminologies (Variable/features, Input, Output, Model, Learning Algorithm, Hypothesis, Cost/Loss function) **Linear Regression**: Single Variable (Representation of hypothesis, cost function, Optimization: Sum of squared error (L1 and L2), parameters/weights, bias) without bias and with bias. **Model Optimization**: Introducing Iterative optimization (Sum of squares error function, Gradient descent algorithm) and non-iterative optimization. **Linear Regression: Polynomial Regression and Multi-variable Regression** (Representation of hypothesis, cost function, Optimization).Model Optimization: Gradient descent algorithm (Learning rate/ step size, Normalization/ Feature Scaling).Model Optimization: Non-iterative optimization (Normal Equation).**Logistic Regression**: Hypothesis Representation, Decision boundary, Cost function, Logistic Regression: Optimization (Gradient Descent), **Multi-class classification** (One-vs.-all classification using logistic regression), **Classical supervised learning algorithm**- Support Vector Machine (SVM)	08
Chapter No. 3 Performance Evaluation **Performance Evaluation of learning models**: Metrics (Confusion matrix, Precision, Recall, F1 Score, RoC curves), Modeling data and validating learning, over fitting, Trade of Bias and Variance, Methods to overcome over fitting (Feature reduction, Regularization)	04
Unit - 2	
Chapter No. 4 Unsupervised Learning **Clustering**: Introduction, K-means Clustering, Algorithm, Cost function, Applications, **Dimensionality Reduction**: Motivation, Definition, Methods of Dimensionality reduction, Dimensionality Reduction: PCA- Principal Component Analysis	05
Chapter No. 5 Introduction to Neural Network and deep learning **Introduction to Neural Networks** (Motivation: non-linear model, Neurons and perception), Model representation: Neural Network Architecture (Activation units, Layers), **Neural Network**: Initialization, Forwards propagation, and Cost function, Back propagation algorithm, Multi-class classification, Steps to train a neural network, Applications of Neural Networks, **Introduction to Deep Learning** (Motivation, Overview), Convolution Neural Networks (CNN) (Architecture, terminologies, Evolution and Modelling)	10 hrs.
Unit – 3	
Chapter No. 6 Deep learning algorithms Recurrent Neural Networks (RNN), Self-supervised models (Auto encoders and variants),Generative Models (GAN, its variants and applications)	05 hrs.
Chapter No. 7 Sequence to Sequence Learning: Attention networks, Transformer based architecture, Transformer for Time-Series	05 hrs

Text Books (List of books as mentioned in the approved syllabus)

1. Tom Mitchell, Machine Learning, 1, McGraw-Hill, 1997
2. Christopher Bishop, Pattern Recognition and Machine Learning, 1, Springer, 2007

References

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning: Data Mining Inference and Prediction, 2, Springer, 2009

Laboratory Plan

Laboratory Course Plan: BE in BM 2022-2026

Laboratory Title: Biomedical DSP Lab.	**Lab. Code: 22EBMP303**
Total Contact Hours: 42	**Duration of ESA Hours: 3 Hrs**
ISA Marks: 80	**ESA Marks: 20**
Lab .Plan Author: Prof. Priya S Murgod	**Date: 25-02-2024**
Checked By: Dr. Raviraj Havaldar	**Date: 25-02-2024**

Experiment Wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Demonstration		**Total Weightage:**		**No. of lab sessions: 1.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1.	oduction to MATLAB nal processing tool box and commands	1.00		
	Learning Outcomes: The students should be able to: 3. Use different MATLAB commands 4. Plot some basic signals			Basics of Signals
Category: Exercise		**Total Weightage:**		**No. of lab sessions: 1.00**
1.	rify the Sampling theorem.	1.00	5.00	Basics of sampling Theorem
	rning Outcomes: e students should be able to: 1 Test the theorem for different sampling frequencies Apply theoretical concepts practically			
2	mine linear convolution, Circular convolution and Correlation of two given sequences. Verify the result using theoretical computations.	1.00	5.00	
	Learning Outcomes: The students should be able to: 3. Analyze convolution and correlation processes applied to any sequence			Theory of linear/circular convolution, and correlation
3	ermine the linear convolution of two given point sequences using FFT algorithm.	1.00	5.00	

	Learning Outcomes: The students should be able to: 5. Verify convolution operation using FFT 6. Analyze conversion of time domain signal into frequency domain 7. Plot the output waveforms			Fast Fourier transform concept
4	Determine the spectrum of the given sequence using FFT	1.00	5.00	
	Learning Outcomes: The students should be able to: 5. Analyze the frequency components of a signal 6. Plot the magnitude and phase response			MATLAB commands ,FFT theory
5	Design and test Butterworth 1st and 2nd order low & high pass filter	1.00	5.00	Design of Butterworth filter
	Learning Outcomes: The students should be able to: 5. Design 1st and 2nd order Butterworth filter for the given specifications 6. Plot the magnitude and phase response			
6	Write a program to Display Static and Moving ECG signal	1.00	5.00	
	Learning Outcomes: The students should be able to: 5. Use file operations to access external data file 6. Plot the ECG waveform			Basics of ECG
7	Write a program to Compute DFT, FFT, Power spectrum and power spectral density	1.00	5.00	Basics of DFT
	Learning Outcomes: The students should be able to: 1. Compute and plot the power spectrum and spectral density of the signal			
8	e a program to Implement 50Hz notch filter for ECG signal and display PSD	1.00	5.00	Filter design
	Learning Outcomes: The students should be able to: 1.Design Notch filter for 50/60Hz 2.Analyze the spectrum			

9	e a program to Implement Low-Pass FIR filter for ECG	1.00	5.00	Filter design
	Learning Outcomes: The students should be able to: 1.Design Low-pass filter for a given specifications 2.Analyze the spectrum			
10	e a program to detect QRS complex and measure the heart rate of a given ECG signal	1.00	5.00	Basics of CG
	Learning Outcomes: The students should be able to: 1.Verify the algorithm 2. Analyze the waveform			
11	e a program to improve the SNR using signal averaging technique	1.00	5.00	Signal averaging techniques
	Learning Outcomes: The students should be able to: 1.Realize and verify the signal averaging techniques			
12	e a program to obtain the DCT & IDCT of ECG signal	1.00	5.00	Cosine transform
	Learning Outcomes: The students should be able to: 1.Realize and verify functionality of cosine transform 2. Verify the output waveforms			
13	e a program to down sample the given ECG signal	1.00	5.00	Basics of ECG
14	e a program to obtain Adaptive noise cancelling	1.00	5.00	Adaptive noise canceller algorithm
	Learning Outcomes: The students should be able to: 1.Analyze adaptive noise cancelling algorithm 2. Verify the output waveforms			
Category: Structured Enquiry		**Total Weightage: 10.00**		**No. of lab sessions: 2.00**

Expt./ Job No.	Experiment / Job Details	No. of Lab Session(s) per batch (estimate)	Marks / Experiment	Correlation of Experiment with the theory
15	Design and test FIR filter using Windowing method (Hamming, Hanning and Rectangular window) for the given order and cut-off frequency.	1.00	5.00	Design of FIR filter using windowing method.
	Learning Outcomes: The students should be able to: 3. Design and implement FIR filters using different windowing methods for the given specifications 4. Plot the amplitude and frequency spectrum			
16	Write a program to Implement IIR filters for ECG (LPF,HPF, BPF).	1.00	5.00	Filter design
	Learning Outcomes: The students should be able to: 1. Design IIR filter for the given cutoff frequency 2. Plot the amplitude and frequency spectrum			

Text Books:

1. Dimitris G Manolakis, John G. Proakis, "Digital Signal Processing: Principles, Algorithms, and Applications", 4th Edition, Pearson India, 2007.
2. V.Udayashankara, "Modern Digital Signal Processing", Third Edition, PHI 2016
3. Biomedical signal analysis- A case study approach, RangayyanRangaraj, Wiley (IEEE Press)-2005
4. Biomedical Signal Processing- Principles and Techniques - D.C.Reddy, Tata McGraw-Hill, 2005.
5. Biomedical Digital Signal Processing-Willis J.Tompkins, PHI, 2000.

Reference Books:

1. Simon Haykin and Barry Van Veen "Signals and Systems", John Wiley & Sons, 2nd edition
2. S K Mitra, "Digital Signal Processing", 4th Edition, McGraw-Hill, Year
3. Avtar Singh, "Digital Signal Processing Implementation", Brooks Cole

Laboratory Plan

Laboratory Course Plan: BE in BM 2022-2026

Laboratory Title: Medical Image Processing Lab	**Lab. Code: 22EBMP304**
Total Contact Hours: 42	**Duration of ESA Hours: 3 Hrs**
ISA Marks: 80	**ESA Marks: 20**
Lab. Plan Author: Mr. G. A. Hebbale	**Date: 15-02-2024**
Checked By: Dr. Raviraj Havaldar	**Date: 15-02-2024**

Experiment wise Plan

List of experiments / jobs planned to meet the requirements of the course.

Category: Demonstration		**Total Weightage:**		**No. of lab sessions: 1.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1.	play of an image, negative of an image.	1.00	6.00	
	Learning Outcomes: The students should be able to: 5. Use different DOS commands 6. Display Negative of a signal			Basics of Images
2	Contrast stretching of a low contrast image.	1.00	6.00	
	Learning Outcomes: The students should be able to: 4. Analyze a low contrast image.			Basics of Contrast stretching
3	Display of a histogram, and histogram equalization.	1.00	6.00	
	Learning Outcomes: The students should be able to: 8. Display a histogram. 9. Plot the Histogram equalized image.			Basics of Histogram Processing
4	Bit plane slicing of an image.	1.00	6.00	

	Learning Outcomes: The students should be able to: 7. Analyse the contribution of each bit to the overall appearance of the image.			Bit plane slicing of an image.
5	Image enhancement by Intensity/Gray level slicing	1.00	6.00	Basics of Gray Level Slicing
	Learning Outcomes: The students should be able to: 7. Understand the concept of Gray level slicing.			
6	Implementation of FT for an image.	1.00	7.00	
	Learning Outcomes: The students should be able to: 1.Understand the relevance of Fourier Transform in Image Transform			Basics of Fourier Transform
7	Implementation of High pass, Low pass filtering.	1.00	7.00	Basics of low pass and high pass filters
	Learning Outcomes: The students should be able to: 1. Differentiate between high pass and low pass filtering in an image.			
8	Mean and Median filtering of an image.	1.00	7.00	Mean and Median filtering
	Learning Outcomes: The students should be able to: 2. Understand the difference between Mean and Median type of filters and their applications			
9	Implementation of image sharpening filters and edge detection using gradient filters.	1.00	7.00	Basics of sharpening filters
	Learning Outcomes: The students should be able to: 1. Implementation of image sharpening filters			
10	Image Rotation (Clockwise and anticlockwise) and Flipping (Horizontal and Vertical)	1.00	7.00	Image Manipulation techniques
	Learning Outcomes: The students should be able to: 1. Perform different operations on the image.			

11	Image compression	1.00	7.00	Image compression techniques
	Learning Outcomes: The students should be able to: 1. understand different compression techniques			
Category: Structured Enquiry		**Total Weightage: 10.00**		**No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
12	13. Implementation of image segmentation techniques..	1.00	08.00	Segmentation techniques.
	Learning Outcomes: The students should be able to: Implement different image segmentation techniques..			

Text Books:

1. Digital Image Processing - Rafael. C. Gonzalez and Richard. E. Woods, Third Edition, Pearson Education, 2008.

Reference Books:

1. Fundamentals of Digital Image Processing - Anil K. Jain, 5th Indian Print, PHI, 2002.
2. Digital Image Processing and Computer Vision - Milan Sonka, India Edition, CengageLearning

Course Content (7th Sem)

Course Code: 22EBMC401	Course: Medical Imaging Systems	
L-T-P-Self Study: 4-0-0	Credits: 4	Contact Hrs.: 50
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs.: 50		Exam Duration: 3 hrs.

Content	Hrs.
Unit - 1	
Chapter 1: Principles of X-Ray Imaging: X-Ray Imaging: Fundamentals of X-ray – Electromagnetic radiation, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and Detection of X-rays – X-ray generation, X-ray generators, Filters, Beam restrictors and grids, Intensifying screens, fluorescent screens, and image intensifiers, X-ray detectors, Biological effects of ionizing radiation. X-Ray Diagnostic Methods: Conventional X-ray radiography, Fluoroscopy, Angiography, Mammography and Xeroradiography. Computed Tomography: Conventional tomography, Computed tomography – Projection function, Algorithms for image reconstruction, CT number, Spiral CT. Recent developments – Digital radiography, Digital subtraction angiography (DSA), Dynamic spatial reconstructor (DSR).	10 hrs.
Chapter 2: Principles of Ultrasound Imaging: Ultrasound Imaging: Fundamentals of acoustic propagation - Characteristic impedance, Intensity, Reflection and refraction, Attenuation, Doppler effect. Generation and detection of Ultrasound- Piezoelectric effect, Ultrasonic transducers, Axial and Lateral resolution, Focusing, Arrays. Ultrasonic Diagnostic Methods: Pulse echo systems- Amplitude mode (A-mode), Brightness mode (B-mode), Motion mode (M-mode), Doppler methods, Duplex imaging, Tissue characterization, Colour Doppler flow imaging, Image characteristics – Ultrasonic texture or speckle, Speckle reduction, Compensation of phase aberration, Biological effects of ultrasound.	10 hrs.
Unit - 2	
Chapter 3: Radionuclide Imaging: Introduction, Fundamentals of Radioactivity – Nuclear particles, Nuclear activity and half-life, Units of measuring nuclear activity, Specific activity, Interaction of nuclear particles and matter, Attenuation of Gamma radiation, Radionuclides, Generation & Detection of Nuclear Emission – Radionuclide generators, nuclear radiation detectors, Collimators, Diagnostic methods using radiation detector probes – Thyroid function test, Renal function test, Blood volume measurement, Radionuclide imaging systems- Rectilinear scanner, Scintillation camera, SPECT, PET.	10 hrs.
Chapter 4: Thermal Imaging: Medical thermography, Physics of thermography, Infrared detectors, Thermo graphic equipment, Quantitative medical thermography, Pyro electric vidicon camera, Thermal camera based on IR sensor with digital focal plane array. Introduction to body section Radiography, Pan tomography.	10 hrs.
Unit - 3	
Chapter 5: MRI Imaging: Basics of Magnetic Resonance Imaging: Fundamentals of nuclear magnetic resonance- Angular momentum, magnetic dipole moment, magnetization, Larmor frequency, Free induction decay (FID), Fourier spectrum of the NMR signal, Spin density, Relaxation times, Pulse sequences. MRI System & Imaging Methods: Introduction, Magnet, NMR Coil/Probe, Transmitter, Receiver, Data acquisition system. Characteristics of MRI images- Spatial resolution, image contrast. Biological effects of magnetic fields.	10 hrs.

Text Books (List of books as mentioned in the approved syllabus)

1. Principles of Medical Imaging – by Kirk Shung, Michael B. Smith and BanjaminTsui, Academic Press, 1992.
2. Handbook of Biomedical Instrumentation – by R.S.Khandpur, 2nd Edition, Tata McGraw Hill, 2003.
3. Fundamentals of Medical Imaging – by Paul Suetens, Cambridge University Press, 2002.
4. The Physics of Medical Imaging – by Steve Webb (Editor), Adam Hilger, Bristol and Philadelphia Publications, 1988.

Course Content

Course Code:22EBME412	Course Title: Medical Device Regulations and Safety	
L-T-P-Self Study: 3-0-0-0	Credits: 3	Contact Hrs: 40
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Content	Hrs
Unit - 1	
Chapter 1. **Introduction**: The medical device as an entity: What is a medical device?, Defining the device, The product definition process, Overview of quality function deployment, The QFD process, The business proposal Reliability: Definition, Quality Vs Reliability, Reliability Vs Unreliability, Types of Reliability, Optimizing reliability, Reliability's effects on medical devices. Concept of Failure: Causes of Failure, Practical aspects of failure, Failure rates, Hardware failure, Software Failure, Failure due to human errors, Failures from customer's point of view.	7hrs.
Chapter 2. **Safety and Risk Management:** Medical device safety and risk management, Effectiveness/performance of medical devices, Phases in the life span of a medical device, The risk management processes, Tools for risk estimation, Participants in ensuring the safety of medical devices, The role of each participant/stakeholder, Shared responsibility for medical device safety and performance	7hrs.
Unit - 2	
Chapter 3. **Global Harmonization Task Force (GHTF):** Objectives, Scope of the four GHTF study groups, Benefits of the GHTF, Final documents from the GHTF, Global Medical Device Nomenclature (GMDN) The Food and Drug Administration: History of device regulation, Device classification, Registration and listing, The 510 (k) Process, Declaration of conformance to a recognized standard, The PMA application, Investigational Device Exemptions (IDEs), Good Laboratory Practices (GLPs), Good Manufacturing Practices(GMPs), Human Factors, Design Control, The FDA and Software, Software classification, The FDA Inspection.. .	7hrs.
Chapter 4. **The European Union:** European Directives, European Standardization Bodies, European Standards Development Process, Other European Standards Considerations, Conformity Assessment and Testing, European Organization for Testing and Certification, the NVCASE Program The Medical Devices Directives: Definition of a medical device, The Medical Devices Directives process, Choosing the appropriate directive, Identifying the applicable essential requirements, Identification of corresponding harmonized standards, Essential requirements, Classification of the medical devices, identification and choice of a notified body.	7 hrs.
Unit - 3	
Chapter 5. **Standards and Regulations Background**: Standards: What are standards? Voluntary and mandatory standards, Standards development process, Conformity assessment with standards, National and international standards systems, Identification of standards, Current trends in the use of standards in medical device regulations. The ISO 9000 Series of Standards.	06 hrs.

Chapter 6. **Software and Quality system regulation**: Software as a Technology, Domestic Software Regulations, Domestic Software Standards, International Software Regulations, International Software Standards, The Move Toward One Software Standard History of the quality system regulations, Scope, General provisions, Quality system, Design controls, Document controls, Purchasing controls, Identification and traceability, Production and process controls, Acceptance activities, Non-conforming product, Corrective and preventive action.	06 hrs

Text Books:

1. Reliable Design of Medical Devices, Second Edition by Richard Fries, CRC Press, 2006
2. Medical Device Quality Assurance and Regulatory Compliance by Richard C Fries, CRC Press, 1998.

Reference Books:

Medical device regulations: global overview and guiding principles By Michael Cheng, World Health Organization.

Product Safety in the European Union by GáborCzitán, Attila Gutassy, Ralf Wilde, TÜVR heinland Akadémia, 2008.

Course Content

Course Title: Medical IoT	**Course Code:22EBMC423**
L-T-P: 3-0-0	**Credits: 3**
Category: PC	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**

Unit - 1	
Chapter 1: FUNDAMENTALS OF IoT- Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.	08 Hours
Chapter 2: IoT PROTOCOLS- IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks,6LoWPAN, Application Transport Methods: SCADA, Application Layer Protocols: CoAP and MQTT.	08 Hours
Unit - 2	
Chapter 3: DESIGN AND DEVELOPMENT- Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, Arduino Board.	08 Hours
Chapter 4: DATA ANALYTICS AND SUPPORTING SERVICES: Data Analytics: Introduction, Structured Versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring, Organizing in IoT/M2M.	08 Hours
Unit - 3	
Chapter 5: Supporting Services: Computing Using a Cloud Platform for IoT/M2M Applications/Services, Everything as a service and Cloud Service Models. Healthcare IoT/Case Studies: IoT applications in Hospitals, infrastructures, buildings, security, Clinical appliances.	08 Hours

Text Books:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
2. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015
3. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill HigherEducationThe Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit2).

Reference Books:

1. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
2. Architecting the Internet of Things,Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer,2011.
3. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O"Reilly Media, 2011. "

Course Content

Course Code: 22EBME434	Course Title: Lasers and Optical Fibers in Medicine	
L-T-P : 3-0-0	Credits: 3	Contact Hrs.: 3
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs.: 50Hrs		Exam Duration: 3 Hrs.

Content	Hrs.
Unit - 1	
Chapter 1. Applications Of Lasers In Therapy & Diagnosis: Introduction, laser assisted diagnosis and therapy fundamentals, interaction of laser beams and materials-principles (except 3.3.4), Laser interaction with tissue-principles, laser assisted diagnostics-principles, applications of lasers in diagnosis and imaging advances, laser surgery and therapy-principles photo-thermal & photomechanical mechanisms, thermal interaction between laser and tissue-advances.	10 hours
Chapter 2. Single Optical Fibers: Introduction, historical background, optical fibers-fundamentals, light transmission in optical fibers-principles, Optical properties of optical fibers-advances, fabrication of optical fibers-principles, optical fibers for UV, visible, IR light-principles, Power transmission through optical fibers-principles, modified fiber ends and tips-principles, fiber lasers advances.	10 hours
Unit - 2	
Chapter 3. Optical Fiber Bundles: Introduction, non-ordered fiber-optic bundles for light guides-fundamentals & principles, ordered fiber-optic bundles for imaging devices-fundamentals & principles, fiber-scopes and endoscopes fundamentals, fiber optic imaging systems-advances.	10 hours
Chapter 4. Endoscopy: Introduction, endoscopic imaging systems-fundamentals, principles, advances, endoscopic diagnostics-advances, endoscopic therapy fundamentals, endoscopic ultrasound imaging-principles.	10 hours
Unit - 3	
Chapter 5. Clinical Applications Of Fiber Optic Laser Systems: Introduction, fiber-optic laser systems in cardiovascular disease (except 9.2.6), gastroenterology, gynecology, neurosurgery, oncology, ophthalmology, orthopedics, Otolaryngology (ENT), urology, flow diagram for laser angioplasty & photodynamic therapy.	10 Hours

Text Books:

1. Lasers and Optical Fibers in Medicine - by Abraham Katzir, Academic Press, 1998.

Reference Books:

2. Lasers in Medicine - by Ronal W. Waynant, CRC Press, 2002.

Course Content

Course Title: **Senior Design Project**	Course Code:**22EBMW401**
L-T-P: 0-0-6	Credits: 6
Category: PC	Contact Hours: 12
ISA Marks: 50	ESA Marks: 50

Guide lines for selection of a project:

- The project needs to encompass the concepts learnt in the previous semesters, so that the student will learn to integrate, the knowledge base acquired to provide a solution to the defined problem statement of the project work.
- Student can select a project which leads to a product or model or prototype.
- Time plan: Effort to do the project should be between 60-70 Hrs. per team, which includes self-study of an individual member (80-100 Hrs.) and team work (40-50hrs).
- Learning overhead should be 20-25% of total project development time.

Criteria for group formation:

- 3-4 students in a team.
- Role of teammates: Team lead and members.

Allocation of Guides and Mentors for the projects:
Every Project batch will be allocated with one faculty.

Details of the project batches:

- Number of faculty - members: 5
- Number of students: 3-4 students in a team.

Role of a Guide

The primary responsibility of the guide is to help students to understand the meaning and need of various stages in the implementation of the project. At every stage of the project development, guide should help towards its successful completion as per the predefined standards.

How student should carry out a project:

- Define the problem.
- Specify the requirements.
- Specify the design in the understandable form (Block Diagram, Flowchart, Algorithm, etc).
- Analyze the design and identify hardware and software components separately.
- Select appropriate simulation tool and development board for the design.
- Implement the design.
- Optimize the design and generate the results.
- Result representation and analysis.
- Prepare a document and presentation.

Report Writing

- The format for report writing should be downloaded from ftp://10.3.0.3/projects
- The report needs to be shown to guide and committee for each review.

Evaluation Scheme

- Internal semester assessment (ISA)
- Evaluation is done based on the evaluation rubrics.
- Project shall be reviewed and evaluated by the concerned Guide for 50% of the marks.
- Project shall be evaluated by the review committee for 50% of the marks.

Course Content

Course Title: CIPE	**Course Code: 15EHSA401**
L-T-P: 2-0-0	**Credits: Audit**
Category:	**Contact Hours: 2 hrs/week**
ISA Marks: 50	**ESA Marks: 50**

Unit - 1	
Chapter No. 1 Features of Indian Constitution Features of Indian Constitution, Preamble to the constitution of India, Fundamental rights under Part III – details of Exercise of rights, Limitations & Important cases. Berubari Union and Exchange of Enclaves, Kesavanand Bharati vs. UOI, Maneka Gandhi vs. UOI, Air India Ltd. vs. NargeesMeerza, T.M.A. Pai Foundation v. St. of Karnataka, M.C. Mehta vs. UOI etc., **Chapter No. 2** Relevance of Directive principles of State Policy Relevance of Directive principles of State Policy under Part IV, Fundamental duties & their significance. SarlaMudgal v. UOI **Chapter No. 3** Union Union – President, Vice President, Union Council of Ministers, Prime Minister, Parliament & the Supreme Court of India. **Chapter No.4** State State – Governors, State Council of Ministers, Chief Minister, State Legislature and Judiciary. **Chapter No. 5** Constitutional Provisions for Scheduled Castes & Tribes Constitutional Provisions for Scheduled Castes & Tribes, Women &Children & Backward classes, Emergency Provisions. **Chapter No. 6** Electoral process Electoral process, Amendment procedure, 42nd, 44th and 86th Constitutional amendments.	08 Hours
Unit - 2	
Chapter No. 7 Scope & Aims of Engineering Ethics Scope & Aims of Engineering Ethics: Meaning and purpose of Engineering Ethics, Responsibility of Engineers, Impediments to responsibility, Honesty, Integrity and reliability, risks, safety & liability in engineering. Bhopal Gas Tragedy, Titanic case. **Chapter No. 8** Intellectual Property Rights Intellectual Property Rights (IPRs)- Patents, Copyright and Designs **Chapter No. 9** Ethical perspectives of professional bodies Ethical perspectives of professional bodies- IEEE, ASME, NSPE and ABET, ASCE etc.	08 Hours
Unit - 3	
Chapter No. 10 Effects of human activities on environment Effects of human activities on environment - Agriculture, Housing, Industry, Mining, and Transportation activities, Environmental Impact Assessment, Sustainability and Sustainable Development. **Chapter No. 11** Environmental Protection Environmental Protection – Constitutional Provisions and Environmental Laws in India..	08 Hours
Text Book (List of books as mentioned in the approved syllabus) 1. Dr. J. N. Pandey, "Constitutional Law of India", Central Law Agency, 2005 2. Dr. M.K. Bhandari, "Law relating to Intellectual Property Rights", Central Law Publications, Allahabad, 2010. 3. Charles E. Harris and others, "Engineering Ethics: Concepts and Cases", Thomson **References** 1. Durga Das Basu, "Introduction to the Constitution of India", Prentice-hall EEE, 2001 2. Mike Martin and Ronald Schinzinger, "Ethics in Engineering", Tata McGraw-Hill Publications.	

Course Plan Semester VIII

Professional Elective

Program: Bachelor of Engineering (Biomedical Engineering)	**Semester: VIII**
Course Title: Artificial Organs and Biomaterials	**Course Code: 22EBME461**
L-T-P: 3-0-0	**Credits: 3**
Category: Elective	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**

Unit - 1	
Chapter 1: Biomaterials: Introduction to biomaterials, uses of biomaterials, biomaterials in organs & body systems, materials for use in the body, performance of biomaterials. Metallic Biomaterials: Introduction, Stainless steel, Cobalt- Chromium alloy, Titanium alloys, Titanium-Nickel alloys, Dental metals, Corrosion of metallic implants, Manufacturing of implants. Ceramic Biomaterials: Introduction, non-absorbable/relatively bioinert-bioceramics, biodegradable/resorbable ceramics, bio reactive ceramics, deterioration of ceramics, bio ceramic manufacturing techniques	08 Hours
Chapter 2: Polymeric Biomaterials: Introduction, polymerization and basic structure, polymers used as biomaterials, sterilization, surface modifications to for improving biocompatibility. Composite Biomaterials: Structure, bounds on properties, anisotropy of composites, particulate composites, fibrous composites, porous materials, biocompatibility. Biodegradable Polymeric Biomaterials: Introduction, Glycolide based biodegradable homopolymers polyesters, non-glycolide linear aliphatic polyesters, aliphatic and aromatic polycarbonates, and biodegradation properties of synthetic biodegradable polymers. Tissue Derived Biomaterials: Structure and properties of collagen and collagen-rich tissues, biotechnology of collagen, design of resorb able collagen-based medical implant.	08 Hours
Unit - 2	
Chapter 3: Hard Tissue Replacements: Bone repair and joint implants-long bone repair and joint replacements, dental implants- effects of material selection, effects of surface properties, surface chemistry. Preservation Techniques For Biomaterials: Phase behavior, nonfreezing storage-hypothermic, freeze-thaw technology, freeze-drying, and verification. Artificial Organs: Introduction: Substitutive medicine, outlook for organ replacement, design consideration, evaluation process.	08 Hours
Chapter 4: Artificial Heart And Circulatory Assist Devices: Engineering design, Engg design of artificial heart and circulatory assist devices, blood interfacing implants – introduction, total artificial hearts & ventricular assist devices, vascular prostheses, Non-blood interfacing implants for soft tissues- sutures and allied augmentation devices, percutaneous and skin implants, maxillofacial implants, eye and ear implants. Cardiac Valve Prostheses: Mechanical valves, tissue valves, current types of prostheses, tissue versus mechanical, engineering concerns and hemodynamic assessment of prosthetic heart valves, implications for thrombus deposition, durability, current trends in valve design, vascular grafts-history, synthetic grafts, regional patency, thrombosis, neointimal hyperplasia, graft infections. Artificial Kidney: Functions of the kidneys, kidney disease, renal failure, renal transplantation, artificial kidney, dialyzers, membranes for hemodialysis, hemodialysis machine, peritoneal dialysis equipment-therapy format, fluid and solute removal.	08 Hours
Unit - 3	
Chapter 5: Artificial Blood: Artificial oxygen carriers, fluorocarbons, hemoglobin for oxygen carrying plasma expanders, hemoglobin based artificial blood. Artificial Lungs: Gas exchange	08 Hours

systems, Cardiopulmonary bypass (heart-lung machine)-principle, block diagram and working, artificial lung versus natural lung. Liver functions, hepatic failure, liver support systems, general replacement of liver functions. Artificial Pancreas: Structure and functions of pancreas, endocrine pancreas and insulin secretion, diabetes, insulin, insulin therapy, insulin administration systems. Tracheal replacement devices, laryngeal replacement devices, artificial esophagus Artificial Skin: Vital functions of skin, current treatment of massive skin loss, design principles for permanent skin replacement	

Course outcomes

At the end of the course the student will be able to :

1. Explain the principle and biology underlying the design of implants and artificial organs.
2. Differentiate classes of materials used in medicine.
3. Discuss the application of biomaterials in medicine.
4. Discuss concept of biocompatibility and the methods of biomaterial testing.
5. Discuss the design process in some of the prominent artificial organs.

Text Books:

1. Biomedical Engineering Handbook-Volume1 (2nd Edition) by J.D.Bronzino (CRC Press /IEEE Press, 2000).
2. Biomedical Engineering Handbook-Volume 2 (2nd Edition) by J.D.Bronzino (CRC Press /IEEE Press, 2000)
3. Handbook of Biomedical Instrumentation (2nd Edition) by R.S.Khandpur (Tata McGraw Hill, 2003).

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Program: Bachelor of Engineering (Biomedical Engineering)	**Semester: VIII**
Course Title: Computer Communication in Health Care Networking	**Course Code: 22EBME462**
L-T-P: 3-0-0	**Credits: 3**
Category: Elective	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**

Unit - 1	
Chapter 1: Computer Networks In Health Care: Introduction, history, impact of clinical data, information types, platforms, current technologies, identifier standards, communication (message format) standards. Introduction To Computer Networks: Uses of Computer Networks: Business Applications, Home Applications, Mobile Users. Network Hardware: Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Wireless Networks. Network Software: Design Issues for the Layers, Connection – Oriented and Connectionless Services, Service primitives. The Relationship of Services to Protocols. Reference Models: The OSI Reference3 Model, The TCP/IP Reference Model, A Comparison of the OSI and TCP/IP Reference Models. Example Networks: Internet Usage, Architecture of the Internet, Connection– Oriented Networks: X.25, Frame Relay, and ATM.	08 Hours
Chapter 2: The Physical Layer: The Theoretical Basis For Data communication: Bandwidth Limited Signals, The Maximum Data Rate of a Channel. Guided Transmission Media: Magnetic Media, Twisted Pair, Coaxial Cable, Fiber Optics. Wireless Transmission: The Electromagnetic Spectrum, Radio Transmission, Microwave Transmission, Infrared and Millimeter Waves, Light wave Transmission. The Public Switched Telephone Network: Structure of the Telephone System. Trunks and Multiplexing: FDM, WDM&TDM, Switching, Internet over Cable	08 Hours
Unit - 2	
Chapter 3: The Data Link Layer: Data Link Layer Design Issues: Services Provided to the Network Layer, Framing, Error Control, Flow Control. Elementary Data Link Protocols: A Simplex Stop–and–Wait Protocol. Sliding Window Protocols: A One – Bit Sliding Window Protocol, A Protocol Using Go Back N, A Protocol Using Selective Repeat, HDLC –High – Level Data Link Control, The Data Link Layer in the Internet.	08 Hours
Chapter 4: The Medium Access Control Sub layer: Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access Protocols, Wireless LAN Protocols. Ethernet: Ethernet Cabling, Manchester Encoding, The Ethernet MAC Sub layer Protocol, The Binary Exponential Back off Algorithm, Ethernet Performance. Wireless Lans: The 802.11 Protocol Stack, The 802.11 Physical Layer, The 802.11 MAC Sub layer Protocol, The 802.11 Frame Structure, Services.	08 Hours
Unit – 3	
Chapter 5: Blue Tooth: Blue tooth Architecture, Bluetooth Applications. Data Link Layer SWITCHING: Local Internet Working, Repeaters, Hubs, Bridges, Switches, Routers, and Gateways, Virtual LANs. The Network Layer: Network Layer Design Issues: Store-and- Forward Packet Switching, Services Provided to the Transport Layer, Implementation of Connectionless Service, Implementation of Connection –Oriented Service. Routing Algorithms: The Optimality Principle, Shortest Path Routing, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, CONGESTION control Algorithms: General Principles of Congestion Control.	08 Hours

Quality of Service: Requirements, Techniques for Achieving Good Quality of Service-leaky bucket algorithm, token bucket algorithm. Internetworking: How Networks Differ, How Networks Can Be Connected. The Network layer In The Internet: The IP Protocol, IP Address Formats, IPV6 Header Format.	

Course Outcomes:

At the end of the course the student will be able to :

1. Explain the different formats of data generated in clinical field or Medical field.
2. Discriminate the functionality between the layers in OSI model and TCP/IP suite.
3. Discuss the concept of physical and data link layer.
4. Distinguish the IEEE standards designed to understand the interconnectivity between different LANs.
5. Apply different algorithms to route a packet to the destination for process to process delivery.

Text Books:

1. Computer Networks – Andrew S. Tanenbaum, 4thEdn, Pearson Education / PHI, 2004.

Reference Books:

1. Data and Computer Communication – William Stallings, 7th Edition, Pearson Education, 2004.
2. Data Communications and Networking – Behrouz A Forouzan, 4th Edition, Tata McGraw Hill, 2006.
3. Computer Networking – Kurose and Ross, Pearson Education, 2004.

Program: Bachelor of Engineering (Biomedical Engineering)	**Semester: VIII**
Course Title: Medical Informatics and Expert systems	**Course Code:22EBME463**
L-T-P: 3-0-0	**Credits: 3**
Category: Elective	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**

Unit - 1	
Chapter 1: Medical Informatics: Aim and scope, salient feature, Introduction, history, definition of medical informatics, bio-informatics, online learning, introduction to health informatics, prospectus of medical informatics. Hospital Management And Information Science: Introduction, HMIS: need, Benefits, capabilities, development, functional areas. Modules forming HMIS, HMIS and Internet, Pre-requisites for HMIS client server technology, PACS, why HMIS fails, health information system, disaster management plans, advantages of HMIS.Text1: (Section I - 1 and 2, Section II-3)	08 Hours
Chapter 2: Hospital Management And Information Systems-Structure And Functions :Central Registration Module, OPD / Consultant Clinic / Polyclinic Module, Indoor Ward Module, Patient Care Module, Procedure Module, Diet Planning Module, MLC Register Module, Pathology Laboratory Module, Blood Bank Module, Operation Theatre Module, Medical Stores Module, Pharmacy Module, Radiology Module, Medical Records Index Module, Administration Module, Personal Registration Module, Employee Information Module, Financial modules, Health & Family Welfare, Medical Examination, Account Billing, Medical Research, Communication, General Information. Text 1: (Section II-6)	08 Hours
Unit - 2	
Chapter 3: Computer Assisted Medical Education: CAME, Educational software, Simulation, Virtual Reality, Tele-education, Tele-mentoring. Computer Assisted Patient Education: CAPE, patient counseling software. Computer assisted surgery (CAS), Limitations of conventional surgery, 3D navigation system, intra-operative imaging for 3D navigation system, merits and demerits of CAS.Text1: (Section III – 7 & 8)	08 Hours
Chapter 4: Telecommunication Based Systems: Tele-Medicine, Need, Advantages, Technology-Materials and Methods, Internet Tele-Medicine, Applications. Tele-Surgery: Tele-surgery, Robotic surgery, Need for Tele-Surgery, Advantages, Applications.Text1: (Section V- 13 & 14)	08 Hours
Unit - 3	
Chapter 5: Knowledge Based And Expert Systems: Introduction, Artificial Intelligence, Expert systems, need for Expert Systems, materials and methods- knowledge representation & its methods, production rule systems, algorithmic method, OAV, object oriented knowledge, database comparisons, statistical pattern classification, decision analysis, tools, neural networks, advantages of ES, applications of ES. Text 1: (Section II – 4)	08 Hours

Text Books:

1. Medical Informatics: A Primer - by Mohan Bansal, 1st Print, Tata McGraw Hill, Publications, 2003.
2. Medical Informatics: Computer Applications in Health Care and Biomedicine by E.H.Shortliffe, G. Wiederhold, L.E.Perreault and L.M.Fagan, 2ndEdition, Springer Verlag, 2000.
3. Handbook of Medical Informatics by J.H.VanBemmel, Stanford University Press/ Springer, 000.

Program: Bachelor of Engineering (Biomedical Engineering)	**Semester: VIII**
Course Title: Biomechanics	**Course Code:22EBME464**
L-T-P: 3-0-0	**Credits: 3**
Category: Elective	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**

Unit - 1	
Chapter 1: Biomechanics Applications to Joint Structure and Function: Introduction to Kinematics, Displacement in space, Force vectors and gravity, Linear forces and concurrent forces. Kinetics of rotary and translatory forces. Classes of levers. Close chain force analysis. Constitutive Equations: Equations for Stress and Strain, Non-viscous fluids, Newtonian viscous fluids, Elastic solids. Visco-elasticity andits applications in biology.	08 Hours
Chapter 2: Joint Structure and Function: Properties of connective tissues; Human Joint design; Joint Function and changes in disease. Integrated Functions: Kinetics and Kinematics of Postures; Static and Dynamic Postures; Analysis of Standing, Sitting and Lying Postures.	08 Hours
Unit - 2	
Chapter 3: Gait Analysis: Gait cycle and joint motion; Ground reaction forces; Trunk and upper extremity motion; internal and external forces, moments and conventions; Gait measurements and analysis. Force Platform and Kinematic Analysis: Design of force platforms, Integrating force and Kinematic data; linked segment, free-body analysis.	08 Hours
Chapter 4: Bio-Viscoelastic Fluid: Viscoelasticity, Viscoelastic Models: Maxwell, Voigt and Kelvin Models Response to harmonic variation. Use of viscoelastic models. Bio-Viscoelastic fluids: Protoplasm. Mucus, saliva, semen, synovial fluids.	08 Hours
Unit - 3	
Chapter 5: Rheology of Blood in Microvessels: Fahreus·Lindqulsteffect and inverse effect, hematocrit in very narrow tube. Finite Element Analysis in Biomechanics: Model creation,Solution, Validation of results and applications of FEA.	08 Hours

Text Books:

1. Biomechanics: Mechanical Properties of living tissues by Y. C. Fung, 2nd Edition, Springer Verlag, 1993.
2. Joint Structure and Function, A Comprehensive Analysis – by Pamela K. Levangie and Cynthia C. Norkin, Jaypee Publications, 4th Edition, 2006.
3. Biomechanics of Human Motion - by T. McClurg Anderson, Sports Pub., 2007.

Elective 2: Open Elective:

Program: Bachelor of Engineering (Biomedical Engineering)	**Semester: VIII**
Course Title: Biostatistics	**Course Code: 22EBMO401**
L-T-P: 3-0-0	**Credits: 3**
Category: Elective	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**

Unit - 1	
Chapter 1: Getting Acquainted With Biostatistics: Introduction, Some Basic Concepts, Measurement and Measurement Scales, Sampling and Statistical Inference, The Scientific Method and The Design of Experiments, Computers and Bio statistical Analysis. (Text Book 1 : Chapter 1) Strategies For Understanding The Meanings Of Data: Introduction, The Ordered array, Grouped Data: The Frequency Distribution, Descriptive Statistics: Measure of Central Tendency, Descriptive Statistics: Measure of Dispersion. (Text Book 1 : Chapter 2)	08 Hours
Chapter 2: Probability: The Basis Of Statistical Inference: Introduction, Two Views of Probability: Objective and Subjective, Elementary Properties of Probability, Calculating the Probability of an Event. (Text Book 1 : 3.1, 3.2, 3.3, 3.4) Probabilistic Features Of Certain Data Distributions: Introduction, Probability Distributions of Discrete Variables, The Binomial Distribution, The Poisson Distribution, Continuous Probability Distributions, The Normal Distribution, The Normal Distribution Applications. (Text Book 1 : Chapter 4)	08 Hours
Unit - 2	
Chapter 3: Probabilistic Features Of The Distributions Of Certain Sample Statistics: Introduction, Sampling Distribution, Distribution of the Sample Mean, Distribution of the Difference Between Two Samples Means, Distribution of the Sample Proportion, Distribution of the Difference Between Two Sample Proportions. (Text Book 1 : Chapter 5) Using Sample Data To Make Estimates About Population Parameters : Introduction, Confidence Interval for a Population Mean, The t Distribution, Confidence Interval for the Difference Between Two Population Means, (Text Book 1 : 6.1, 6.2, 6.3, 6.4)	08 Hours
Chapter 4: Using Sample Data To Make Estimates About Population Parameters: Confidence Interval for a Population Proportion, Confidence Interval for the Difference Between Two Population Proportions, Determination of Sample Size for Estimating Means, Determination of Sample Size for Estimating Proportions, Confidence Interval for the Variance of a Normally Distributed Population, Confidence Interval for the Ratio of the Variances of Two Normally Distributed Populations. (Text Book1 : 6.5, 6.6, 6.7, 6.8, 6.9, 6.10) Using Sample Statistics To Test Hypotheses About Population Parameters: Introduction, Hypotheses Testing: A Single Population Mean. (Text Book 1 : 7.1, 7.2)	08 Hours
Unit - 3	
Chapter 5: Using Sample Statistics To Test Hypotheses About Population Parameters: Hypotheses Testing: The Difference Between Two Population Means, Paired Comparisons, Hypotheses Testing: A Single Population Proportion, Hypotheses Testing: The Difference Between Two Population Proportions, Hypotheses Testing: A Single Population Variance, Hypotheses Testing: The Ratio of Two Population Variances. The Type II Error and the Power of a Test, Determining Sample Size to Control Type II Errors. (Text Book1 : 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 7.10)	08 Hours
Text Books: **1.** Biostatistics: Basic Concepts and Methodology for the Health Sciences – by Wayne W. Daniel, John Wiley & Sons Publication, 9th Edition, 2009. **Reference Books:** 1. Principles of Biostatistics - by Marcello Pagano and Kimberlee Gauvreu,	

Thomson Learning Publication, Indian Edition, 2007.
2. Biostatistics - by Ronald N Forthofer, EunSul Lee and M. Hernandez, Academic Press, 2007.
Basic Biostatistics and its Applications - by Animesh K. Dutta, 2006.

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Program: Bachelor of Engineering (Biomedical Engineering)	**Semester: VIII**
Course Title: Virtual Instrumentation	**Course Code: 22EBMO402**
L-T-P: 3-0-0	**Credits: 3**
Category: Elective	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**

Unit - 1	
Chapter 1: Graphical System Design (GSD): Introduction, GSD model, Design flow with GSD, Virtual Instrumentation, Virtual Instrumentation and traditional instrumentation, Hardware and software in virtual instrumentation, Virtual Instrumentation for test, control and design, GSD using Lab VIEW, Graphical programming and textural programming. Introduction to Lab VIEW: Introduction, Advantages of Lab VIEW, Advantages of Lab VIEW, Software environment, Creating and saving a VI, Front panel toolbar, Block diagram toolbar, Palettes, Shortcut menus, Property dialog boxes, Front panel controls and indicators, Block diagram, Data types, Data flow program, Lab VIEW documentation resources, Keyword shortcuts	08 Hours
Chapter 2: Modular Programming: Introduction, Modular Programming in Lab VIEW, Build a VI front panel and block diagram, ICON and connector pane, Creating an icon, Building a connector pane, Displaying subVIs and express Vis as icons or expandable nodes, Creating subVIs from sections of a VI, Opening and editing subVIs, Placing subVIs on block diagrams, Saving subVIs, Creating a stand-alone application. Data Acquisition: DAQ software architecture, DAQ assistant, Channels and task configurations, Selecting and configuring a data acquisition device, Components of computer based measurement system.	08 Hours
Unit - 2	
Chapter 3: General Goals of Virtual Bio-Instrumentation (VBI): Definition of VBI and importance, General Goals of VBI applications. Basic Concepts: DAQ basics, Lab VIEW basics, Bio Bench basics. Neuromuscular Electrophysiology (Electromyography): Physiological basis, Experiment set up, Experiment descriptions, Troubleshooting the nerve –Muscle Preparation. Cardiac Electrophysiology (Electro cardiology): Physiological basis, Experiment descriptions. Cardiopulmonary Applications: Cardiopulmonary measurement system, How the Cardiopulmonary measurement system works, Clinical Significance	08 Hours
Chapter 4: Medical Device Development Applications: The Endotester – A Virtual Instrument –Based Quality control and Technology, Assessment System for surgical video Systems: Introduction, Materials and Methods, Endoscope Tests, Results, Discussion. Fluid Sense Innovative IV Pump Testing: Introduction, The test System, Training Emulator.	08 Hours
Unit - 3	
Chapter 5: Healthcare Information management Systems: Medical Informatics: Defining medical informatics, Computers in medicine, Electronic Medical record, Computerized physician order entry, Decision support. Information Retrieval, Medical Imaging, Patient Monitoring, Medical Education, Medical Simulation. Managing Disparate Information: ActiveX, ActiveX Data Objects (ADO), Dynamic Link Libraries, Database Connectivity, Integrated Dash boards.	08 Hours
Text Books Virtual Instrumentation using Lab VIEW by Jovitha Jerome, PHI Learning Private Limited, 2010. (Module 1 & 2) "Virtual Bio-Instrumentation" Biomedical, Clinical, and Healthcare Applications in Lab VIEW. , by Jon B. Olansen and Eric Rosow, Prentice Hall Publication, 2002.	

Program: Bachelor of Engineering (Biomedical Engineering)	**Semester: VIII**
Course Title: Image Processing	**Course Code: 22EBMO403**
L-T-P: 3-0-0	**Credits: 3**
Category: Elective	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**

Course content 2-0-1 Theory

Unit - 1	
Chapter 1: . Introduction: Background, Examples of fields that use DIP, Fundamental steps in Digital Image Processing (DIP), Components of DIP system, Image sensing and acquisition, A simple image formation model, Image sampling and quantization. Basic relationship between pixels, Colour image processing fundamentals and models. Text: Chapter 1, 2.3, 2.4, .2.5, 6.1, 6.2	08 Hours
Chapter 2: Image Enhancement in Spatial Domain: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Intensity level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram matching (specification), Arithmetic/Logic operations – Image subtraction, Image averaging. Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters Text: 3.1, 3.2, 3.3, 2.6.1, 2.6.2, 2.6.3, 2.6.4, 3.4, 3.5, 3.6	08 Hours
Unit - 2	
Chapter 3: Image Enhancement In Frequency Domain: Background, 2D-Discrete Fourier Transform and its Inverse, Basic properties of the 2D-Discrete Fourier Transform, Basics of filtering in the frequency domain. Image smoothing using frequency domain filters – Ideal low pass filters, Butterworth low pass filters, Gaussian low pass filters; Image sharpening using frequency domain filters – Ideal high pass filters, Butterworth high pass filters, Gaussian high pass filters, Homomorphic filtering. Text: 4.1, 4.2, 4.5.5, 4.6, 4.7,4.8, 4.9	08 Hours
Chapter 4: Image Restoration: Model of the Image degradation/restoration process, Noise models, Restoration using spatial filtering: Mean filters, Order statistic filters - Median filter, Min and Max filters, Midpoint filter. Image Compression: Fundamentals, Image compression models, Basic compression methods – Huffman coding, Arithmetic coding, LZW coding, Run-length coding. Text: 5.1, 5.2, 5.3.1, 5.3.2, 8.1, 8.2.1, 8.2.3, 8.2.4, 8.2.5	08 Hours
Unit - 3	
Chapter 5: Image Segmentation: Fundamentals, Point detection, Line detection, Edge models, Edge detection, Canny edge detector. Thres holding, Region based segmentation. Text: 10.1, 10.2.1 – 10.2.6, 10.3, 10.4.	08 Hours

Text Books:

1. Digital Image Processing - Rafael. C. Gonzalez and Richard. E. Woods, Third Edition, Pearson
2. Education, 2008.

Reference Books:

4. Fundamentals of Digital Image Processing - Anil K. Jain, 5th Indian Print, PHI, 2002.
5. Digital Image Processing and Computer Vision - Milan Sonka, India Edition, Cengage Learning.

Program: Bachelor of Engineering (Biomedical Engineering)	**Semester: VIII**
Course Title: Medical Physics	**Course Code: 22EBMO404**
L-T-P: 3-0-0	**Credits: 3**
Category: Elective	**Contact Hours: 3**
ISA Marks: 50	**ESA Marks: 50**

Unit - 1	
Chapter 1: X-Ray Imaging: Fundamentals of X-ray – Electromagnetic radiation, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and Detection of X-rays – X-ray generation, X-ray generators, Filters, Beam restrictors and grids, Intensifying screens, fluorescent screens, and image intensifiers, X-ray detectors, Biological effects of ionizing radiation. X-Ray Diagnostic Methods: Conventional X-ray radiography, Fluoroscopy, Angiography, Mammography and Xeroradiography.	08 Hours
Chapter 2: Computed Tomography: Conventional tomography, Computed tomography – Projection function, Algorithms for image reconstruction, CT number, Spiral CT. Recent developments – Digital radiography, Digital subtraction angiography (DSA), Dynamic spatial reconstructor (DSR).	06 Hours
Unit - 2	
Chapter 3: Ultrasound Imaging: Fundamentals of acoustic propagation - Characteristic impedance, Intensity, Reflection and refraction, Attenuation, Doppler effect. Generation and detection of Ultrasound-Piezoelectric effect, Ultrasonic transducers, Axial and Lateral resolution, Focusing, Arrays. Ultrasonic Diagnostic Methods: Pulse echo systems- Amplitude mode (A-mode), Brightness mode (B-mode), Motion mode (M-mode), Doppler methods, Duplex imaging, Tissue characterization, Colour Doppler flow imaging, Image characteristics – Ultrasonic texture or speckle, Speckle reduction, Compensation of phase aberration, Biological effects of ultrasound.	10 Hours
Chapter 4: Radionuclide Imaging: Introduction, Fundamentals of Radioactivity – Nuclear particles, Nuclear activity and half-life, Units of measuring nuclear activity, Specific activity, Interaction of nuclear particles and matter, Attenuation of Gamma radiation, Radionuclides, Generation & Detection of Nuclear Emission – Radionuclide generators, nuclear radiation detectors, Collimators, Diagnostic Methods using radiation detector probes – Thyroid function test, Renal function test, Blood volume measurement, Radionuclide imaging systems- Rectilinear scanner, Scintillation camera, SPECT, PET.	06 Hours
Unit - 3	
Chapter 5: Basics of Magnetic Resonance Imaging: Fundamentals of nuclear magnetic resonance- Angular momentum, magnetic dipole moment, magnetization, Larmor frequency, Free induction decay (FID), Fourier spectrum of the NMR signal, Spin density, Relaxation times, MRI System & Imaging Methods: Introduction, Magnet, NMR Coil/Probe, Transmitter, Receiver, Data acquisition. Imaging Methods- Introduction, slice selection, Characteristics of MRI images- Spatial resolution, image contrast. Biological effects of magnetic fields- Static magnetic fields, Radio-frequency fields, Gradient magnetic fields, Imaging safety,	10 Hours
Text Books: 1. Principles of Medical Imaging – by Kirk Shung, Michael B. Smith and BanjaminTsui, Academic	

Press, 1992.
2. Handbook of Biomedical Instrumentation – by R.S.Khandpur, 2nd Edition, Tata McGraw Hill, 2003.
3. Fundamentals of Medical Imaging – by Paul Suetens, Cambridge University Press, 2002.

Course Title: Project Work		Course Code: 22EBMW402
L-T-P: 0-0-11	Credits: 11	Contact Hours: 22 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: --	Examination Duration: 3 Hrs.	

- Bio Instrument
- Hospital data
- Patient security
- Health care

Guide lines for selection of a project:

- The project needs to encompass the concepts learnt in the previous semesters, so that the student will learn to integrate, the knowledge base acquired to provide a solution to the defined problem statement of the project work.
- Student can select a project which leads to a product or model or prototype.
- Time plan: Effort to do the project should be between 60-70 Hrs. per team, which includes self-study of an individual member (80-100 Hrs.) and team work (40-50hrs).
- Learning overhead should be 20-25% of total project development time.

Criteria for group formation:

- 3-4 students in a team.
- Role of teammates: Team lead and members.

Allocation of Guides and Mentors for the projects:
Every Project batch will be allocated with one faculty.

Details of the project batches:

- Number of faculty - members: 50
- Number of students: 3-4 students in a team.

Role of a Guide
The primary responsibility of the guide is to help students to understand the meaning and need of various stages in the implementation of the project. At every stage of the project development, guide should help towards its successful completion as per the predefined standards.

How student should carry out a project:

- Define the problem.
- Specify the requirements.
- Specify the design in the understandable form (Block Diagram, Flowchart, Algorithm,etc).
- Analyze the design and identify hardware and software components separately.
- Select appropriate simulation tool and development board for the design.
- Implement the design.
- Optimize the design and generate the results.
- Result representation and analysis.
- Prepare a document and presentation.

Report Writing

- The format for report writing should be downloaded from ftp://10.3.0.3/projects
- The report needs to be shown to guide and committee for each review.

Evaluation Scheme

- Internal semester assessment (ISA)
- Evaluation is done based on the evaluation rubrics
- Project shall be reviewed and evaluated by the concerned Guide for 50% of themarks.
- Project shall be evaluated by the review committee for 50% of the marks.

Program: Biomedical Engineering		**Semester: VIII**
Course Title: Internship- Training		**Course Code: 22EBMI401**
L-T-P: 0-0-6	**Credits: 6**	**Contact Hours: 12 hrs/week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: --	**Examination Duration: 3 Hrs.**	

Evaluation parameters for Internship Training

- Initiative and creativity
- Adaptation capacity
- Commitment and perseverance
- Independence
- Handling supervisor's comments and development skills
- Time management
- Formulation goals, framework project
- Theoretical underpinning, use of literature
- Use of methods and processing data
- Reflection on results
- Conclusions and discussion
- Presentation skills

Program: Biomedical Engineering		**Semester: VIII**
Course Title: Internship- Project		**Course Code: 22EBMW403**
L-T-P: 0-0-11	**Credits: 11**	**Contact Hours: 22 hrs./week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: --	**Examination Duration: 3 Hrs.**	

Evaluation parameters for Internship Project

- Initiative and creativity
- Adaptation capacity
- Commitment and perseverance
- Independence
- Handling supervisor's comments and development skills
- Time management
- Formulation goals, framework project
- Theoretical underpinning, use of literature
- Use of methods and processing data
- Reflection on results
- Conclusions and discussion
- Presentation skills