P.S.R. ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)
(Accredited By NBA, NAAC and Listed under 12B of the UGC Act,1956)

Sevalpatti, Sivakasi – 626 140

REGULATION - 2019

Curriculum and Syllabi

for

B.E - BIOMEDICAL ENGINEERING

(1st to 8th Semester)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- **PEO:1** Lead a professional career by acquiring the basic knowledge in the field of specialization and allied Engineering.
- **PEO:2** Assess the real life problems and deal with them confidently relevance to the society.
- **PEO:3** Engage in lifelong learning by pursuing higher studies and participating in professional organizations.
- **PEO:4** Exhibit interpersonal skills and able to work as a team for success.

PROGRAM SPECIFIC OUTCOMES (PSOs)

- **PSO:1**Acquire knowledge on fundamentals of engineering and biological sciences to identify and solve biomedical engineering problems.
- **PSO:2** To design and develop diagnostic and therapeutic devices that reduces physician burnout and enhance the quality of life for the end user by applying fundamentals of Biomedical Engineering.
- **PSO:3**To innovate ideas and solutions for current societal and scientific issues thereby developing indigenous medical instruments that are on par with the existing technology.
- **PSO:4** To apply software skills in developing algorithms for solving healthcare related problems in various fields of Medical sector.

PROGRAMME OUTCOMES (POs)

- **PO:1Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO:2Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO:3Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO:4Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO:5Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

- **PO:6The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO:7Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO:8Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO:9Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO:10Communication:**Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO:11Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO:12Life-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..

Department: BIOMEDICAL ENGINEERING Programme: **B.E. BIOMEDICAL ENGINEERING**

S.No	Theory Courses					Theory Cum Practical	Practical Courses			**Mandatory Courses**	**Value AddedCourses / Audit Courses**	Total Credits
I	191HS11Communicative English (2)	191HS12 Calculus and Linear Algebra (4)	191HS13 Engineering Physics (2)	191HS14 Engineering Chemistry (2)	191EEF1 Basic Electrical and Electronics Engineering (3)	191MEF1 Engineering Graphics(3)	191HS17 Physics & Chemistry Laboratory - I (1)	191EE17 Basic Electrical and Electronics Laboratory (1)	-			18
2	191HS21 Technical English (2)	191HS22 Differential Equations and Numerical Methods (4)	191HS23 Physics of Materials (2)	191HS24 Environmental Science (2)	191CSF1 Programming for Problem Solving(3)	191MEF7 Mechanical Workshop (3)	191HS27 Physics & Chemistry Laboratory – II(1)	191CSF7 C- Programming Laboratory(1)	-			18
3	191HS31 Transforms and Discrete Mathematics(3)	191EC31 Circuits and Electronic Devices(4)	191EC32 Linear Integrated Circuits (3)	191BM31 Anatomy and Human Physiology(3)	191BS31 Biology for Engineers (3)	191BT32 Biochemistry (4)	191EC37 Circuits and Devices Laboratory(1)	191BM37 Human Physiology Laboratory(1)	-	191HS37 – Communication Skills - I	VAC	22
4	191HS42 Probability and Statistics (3)	191BM41 Medical Physics (3)	191EC42 Signals and Systems (3)	191EC43 Digital Systems (3)	191BM42- Pathology and Microbiology (3)	191CS35 Data Structure Algorithms & C++ (4)	191BM47 Pathology and Microbiology laboratory (2)	191BM48 Analog and Digital ICs Laboratory(1)	-	191HS47 – Communication Skills - II	AC	22
5	191EC51 Analog and Digital Communication (3)	191BM51 Biomedical Instrumentation (3)	191BM52 Sensors and Measurements (3)	191EC54 Digital Signal Processing and Architecture (4)	PE 1(3)	191EC55 Embedded Systems and IOT (4)	191BM57- Biomedical Instrumentation Laboratory (2)	191EC58 DSP and Signal Processors Laboratory (2)	-	191HS57 – Business English	VAC	24
6	191BM61 Bio Control Systems (3)	191EC62 Machine Learning (3)	191BM62 Hospital Management (3)	PE2 (3)	OE 1(3)	191BM63 Diagnostic and Therapeutic Equipment – I (4)	191EC67- Machine Learning Laboratory(1)	191EC69 Mini Project (1)		191HS67 – Business English	AC	21
7	191EC71 Robotics and Artificial Intelligence (3)	191BM71 Radiological Equipments (3)	191EC72 Digital Image Processing (3)	PE3(3)	OE2(3)	191BM72 Diagnostic and Therapeutic Equipment – II (4)	191EC77 Robotics and Artificial Intelligence Laboratory(1)	191EC78 Digital Image Processing Laboratory (1)	191EC79 Project Work I (2)		VAC	23
8	PE 4 (3)	PE 5 (3)		-	-		191EC87Project Work – II (6)					12
Total Number of Credits												**160**

SEMESTER – I					
S.NO	Course Code	Course Title	Category	L-T-P	C
1.	191HS11	Communicative English	HSMC	2-0-0	2
2.	191HS12	Calculus and Linear Algebra	BSC	3-2-0	4
3.	191HS13	Engineering Physics	BSC	2-0-0	2
4.	191HS14	Engineering Chemistry	BSC	2-0-0	2
5.	191EEF1	Basic Electrical and Electronics Engineering	ESC	3-0-0	3
6.	191MEF1	Engineering Graphics (Theory Cum Practical)	ESC	1-0-4	3
7.	191HS17	Physics and Chemistry Laboratory-I	BSC	0-0-2	1
8.	191EE17	Basic Electrical and Electronics Laboratory	ESC	0-0-2	1
					No. of Credits: 18

SEMESTER – II					
S.NO	Code	Course Title	Category	L-T-P	C
1.	191HS21	Technical English	HSMC	2-0-0	2
2.	191HS22	Differential Equations and Numerical Methods	BSC	3-2-0	4
3.	191HS23	Physics of Materials	BSC	2-0-0	2
4.	191HS24	Environmental Science	BSC	2-0-0	2
5.	191CSF1	Programming for Problem Solving	ESC	3-0-0	3
6.	191MEF7	Mechanical Workshop (Theory Cum Practical)	ESC	1-0-4	3
7.	191HS27	Physics and Chemistry Laboratory-II	BSC	0-0-2	1
8.	191CSF7	C Programming Laboratory	ESC	0-0-2	1
					No. of Credits: 18

SEMESTER – III					
S.NO	Code	Course Title	Category	L-T-P	C
1.	191HS31	Transforms and Discrete Mathematics	BSC	3-0-0	3
2.	191EC31	Circuits and Electronic Devices	PC	3-2-0	4
3.	191EC32	Linear Integrated Circuits	PC	3-0-0	3
4.	191BM31	Anatomy and Human Physiology	PC	3-0-0	3
5.	191BS31	Biology for Engineers	BSC	3-0-0	3
6.	191BM32	Biochemistry (Theory cum Practical)	ESC	3-0-2	4
7.	191EC37	Circuits and Devices Laboratory	PC	0-0-2	1
8.	191BM37	Human Physiology Laboratory	PC	0-0-2	1
					No. of Credits: 22

SEMESTER – IV					
S.NO	Code	Course Title	Category	L-T-P	C
1.	191HS42	Probability and Statistics	BSC	3-0-0	3
2.	191BM41	Medical Physics	PC	3-0-0	3
3.	191EC42	Signals and Systems	PC	3-2-0	4
4.	191EC43	Digital Systems	PC	3-0-0	3
5.	191BM42	Pathology and Microbiology	PC	3-2-0	4
6.	191CS35	Data Structure Algorithms & C (Theory cum Practical)	ESC	3-0-2	4
7.	191BM47	Pathology and Microbiology laboratory	PC	0-0-2	1
8.	191BM48	Analog and Digital ICs Laboratory	PC	0-0-2	1
					No. of Credits: 23

SEMESTER – V					
S.NO	Code	Course Title	Category	L-T-P	C
1.	191EC51	Analog and Digital Communication	BSC	3-0-0	3
2.	191BM51	Biomedical Instrumentation	PC	3-0-0	3
3.	191BM52	Sensors and Measurements	PC	3-2-0	4
4.	191EC54	Digital Signal Processing and Architecture	PC	3-0-0	3
5.	-	Elective I* (PE 1)	PC	3-2-0	4
6.	191EC55	Embedded Systems and IOT (Theory cum Practical)	ESC	3-0-2	4
7.	191BM57	Biomedical Instrumentation Laboratory	PC	0-0-2	1
8.	191EC58	DSP and Signal Processors Laboratory	PC	0-0-2	1
					No. of Credits: 23

SEMESTER – VI					
S.NO	Code	Course Title	Category	L-T-P	C
1.	191BM61	Bio Control Systems	BSC	3-0-0	3
2.	191EC62	Machine Learning	PC	3-0-0	3
3.	191BM62	Hospital Management	PC	3-2-0	4
4.	-	Elective II* (PE 2)	PC	3-0-0	3
5.	-	Elective I* (OE 1)	PC	3-2-0	4

6.	191BM63	Diagnostic and Therapeutic Equipment – I (Theory cum Practical)	ESC	3-0-2	4
7.	191EC67	Machine Learning Laboratory	PC	0-0-2	1
8.	191EC48	Mini Project	PC	0-0-2	1
					No. of Credits: 23

SEMESTER – VII					
S.NO	Code	Course Title	Category	L-T-P	C
1.	191EC71	Robotics and Artificial Intelligence	BSC	3-0-0	3
2.	191BM71	Radiological Equipment's	PC	3-0-0	3
3.	191EC72	Digital Image Processing	PC	3-2-0	4
4.	-	Elective III* (PE 3)	PC	3-0-0	3
5.	-	Elective 1I* (OE 2)	PC	3-2-0	4
6.	191BM72	Diagnostic and Therapeutic Equipment – II (Theory cum Practical)	ESC	3-0-2	4
7.	191EC77	Robotics and Artificial Intelligence Laboratory	PC	0-0-2	1
8.	191EC78	Digital Image Processing Laboratory	PC	0-0-2	1
9.	191EC79	Project Work I			
					No. of Credits: 23

SEMESTER – VII					
S.NO	Code	Course Title	Category	L-T-P	C
1.	-	Elective IV* (PE 4)	BSC	3-0-0	3
2.	-	Elective V* (PE 5)	PC	3-0-0	3
3.	191EC87	Project Work – II	PC	3-2-0	4
					No. of Credits: 23

Programme Elective Courses:

S.No.	Course Code	Course Name
1.	191BME01	Bio MEMS
2.	191BME02	Nano Technology and Applications
3.	191BME03	Biomaterials and Artificial Organs
4.	191BME04	Bio signal Processing
5.	191BME05	Biofluids and Dynamics
6.	191BME06	Physiological Modeling
7.	191BME07	Soft Computing Techniques
8.	191BME08	Neural Engineering
9.	191BME09	Biometric Systems
10.	191BME10	Medical Ethics and Standards
11.	191BME11	Body Area Networks
12.	191BME12	Rehabilitation Engineering
13.	191BME13	Principles of Tissue Engineering
14.	191BME14	Cryptography and Network Security
15.	191BME15	Electro Magnetic Interference and Compatibility
16.	191BME16	Multimedia Compression and Networks
17.	191BME17	VLSI Design
18.	191BME18	Human Rights
19.	191BME19	Virtual Reality and Augmented Reality

Open Elective Courses:

S.No.	Course Code	Course Name
1	191OE901	Telehealth Technology
2	191OE902	Speech Processing
3	191OE903	Internet of Things in Medicine
4	191OE904	Wearable Systems
5	191OE905	Brain Computer Interface and its Applications

AUDIT COURSES

S.No.	Course Code	Course Title	L-T-P	C	Category
1	191AC01	English for Research Paper Writing	2-0-0	-	AC
2	191AC02	Disaster Management	2-0-0	-	AC
3	191AC03	Sanskrit for Technical Knowledge	2-0-0	-	AC
4	191AC04	Value Education	2-0-0	-	AC
5	191AC05	Constitution of India	2-0-0	-	AC
6	191AC06	Pedagogy Studies	2-0-0	-	AC
7	191AC07	Stress Management by Yoga	2-0-0	-	AC
8	191AC08	Personality Development through Enlightenment Skills	2-0-0	-	AC

191HS11	COMMUNICATIVE ENGLISH	L-T-P	C
		2-0-0	2

Programme: B.E./B.Tech. (Common to all Branches) **Sem:** 1 **Category:** HSMC

Prerequisites: -

Aim: To acquire basic Language Skills in order to communicate with English Language Speakers.

Course Outcomes:

The Students will be able to

CO1: Develop the basic reading and writing skills.
CO2: Listen actively and grasp the contents of the speech.
CO3: Develop their speaking skills and speak fluently in real contexts.
CO4: Develop vocabulary of a general kind by developing their reading skills.
CO5: Use the grammar effectively to exhibit their speaking and writing skill.
CO6: Speak in English with clarity.

SHARING INFORMATION RELATEDTO ONESELF, FAMILY AND FRIENDS. 9

Reading – Short comprehension passages, Practice in skimming and scanning. **Writing –** Sentence structures, Developing Hints. **Listening–** Short texts, Short formal and informal conversations. **Speaking** – Introducing oneself, Exchanging personal information. **Language Development** – WH questions, Asking and answering YES or NO questions, Parts of Speech. **Vocabulary Development –** Prefixes & Suffixes, Subject verb Agreement.

GENERAL READING AND FREE WRITING 9

Reading – **Comprehension** – Pre-reading & Post-reading. Comprehension questions (Multiple choice questions, Short questions, Open-ended questions), Short narratives and Descriptions from Newspapers including Dialogues. **Writing –** Paragraph writing, Use of Phrases and Clauses in sentences, Listening Telephonic conversations. **Speaking** – Sharing information of a personal kind, Greetings.

Language Development – Noun Pronoun agreement. **Vocabulary Development** – The Concept of Word Formation. (Norman Lewis' *Word Power Made Easy*)

GRAMMAR AND LANGUAGE DEVELOPMENT 9

Reading – Short texts & Longer passages (Cloze reading). **Writing** – Importance of proper punctuation, Jumbled sentences. **Listening –** Listening to longer texts and filling up the table, Product description, Narratives from different sources. **Speaking –** Asking about routine actions and Expressing opinions.

Language Development – Degrees of Comparison, Pronouns. **Vocabulary Development –** Misplaced modifiers, Relative clauses.

READING AND LANGUAGE DEVELOPMENT. 9

Reading- Comprehension. **Reading** longer texts- reading different types of texts. **Writing**- letter Writing, informal or personal letters-Achieving Coherence. **Listening**- listening to dialogues or conversations and completing exercises based on them. **Speaking**- Speaking about oneself- Speaking about one's friend. **Language Development**- Articles. **Vocabulary Development** – Root words from foreign languages and their use in English.

EXTENDED WRITING 9

Reading- Longer texts- close reading. **Writing**- Organizing principles of paragraphs in documents. **Listening** – Listening to talks, conversations. **Speaking** – Participating in conversations, short group conversations. **Language Development** - Cliches, Tenses. **Vocabulary Development** - Prepositions.

Total Periods: 45

Text books:

1. Board of Editors. *Fluency in English: A course book for Engineering and Technology*.Orient Blackswan, Hyderabad: 2016.
2. Kumar, Sanjay and Pushp Lata. *Communication Skills: A Workbook*. New Delhi: OUP, 2018

References:

1. **www.oxfordonlineenglish.com**
2. **www.ielts.up.com**
3. **www.ted.com**
4. **www.testpreppractice.com**
5. **www.beccambridgeenglish.org**

Extensive Reading

1. Shiv Khera, *You Can Win*, Macmillan Books, New Delhi, 2003.

191HS12	**CALCULUS AND LINEAR ALGEBRA**	**L-T-P**	**C**
		3-2-0	**4**

Programme: **B.E./B.Tech. (Common to all Branches)** **Sem:** **1** **Category:** **BSC**

Prerequisites: Matrices, Differentiation and Integration.

Aim: The course is aimed at developing the basic mathematical skills of engineering students,

Course Outcomes: The students will be able to

CO1: Find the inverse and the positive powers of a square matrix

CO2: Apply the concept of orthogonal reduction to diagonalise the given matrix

CO3: Determine the evolute of curves, Beta and Gamma Functions.

CO4: Apply Lagrangian multiplier method for finding maxima and minima of an unconstrained problem

CO5: Apply the concepts of Differentiation and Integration in Vectors.

CO6: Predict an analytic function, when its real or Imaginary part is known.

MATRICES **12**

Characteristic equation - Eigen Values and Eigen vectors of a real matrix - Properties of Eigen values - Cayley-Hamilton Theorem (without proof) and its application - Orthogonal Transformation of a Symmetric matrix to diagonal form - Quadratic form - Orthogonal reduction to canonical form.

CALCULUS **12**

Radius of Curvature - Cartesian and Parametric Coordinates - Circle of Curvature - Involutes and Evolutes –Beta and Gamma functions and their properties.

MULTIVARIABLE CALCULUS **12**

Partial Derivatives - Total Derivative - differentiation of Implicit function – Jacobian - Taylor's Expansion - Maxima/Minima for function of two variables - Method of Lagrange's multipliers.

VECTOR CALCULUS **12**

Gradient, Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelepiped.

COMPLEX VARIABLE – DIFFERENTIATION **12**

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy– Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function(without proof) – Harmonic conjugate – Construction of analytic functions – Conformal mapping : w = z + c, cz, 1/z, and bilinear transformation.

Total Periods **60**

Text books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th edition, Pearson, Reprint, 2002

References:

1. Veerarajan.*T.*, "Engineering Mathematics for first year", Fourth Edition, Tata Mc-Graw – Hill, New Delhi, 2008.
2. Erwin *Kreyszig*, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. G.B. Thomas and R.L. Finney, "Calculus and Analytic Geometry" 9th Edition, Pearson, Reprint, 2002.

4. N.P. Bali and Manish Goyal, “A text book of Engineering Mathematics”, Laxmi Publications, Reprint, 2008.
5. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 36th Edition, 2010.
6. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Edition., Mc-Graw Hill, 2004

191HS13	ENGINEERING PHYSICS	L-T-P	C
		2-0-0	2

Programme:	**B.E./B.Tech. (Common to all Branches)**	**Sem:**	**1**	**Category:**	**BSC**

Prerequisites: School Level Physics

AIM: To endow the students with the fundamentals of Physics and apply new ideas in the field of Engineering and Technology.

Course Outcomes:

The Students will be able to

CO1: Understand the theory and various crystal structures.

CO2:Know about the basic configuration of a Laser, types of lasers and the industrial applications of Laser.

CO3: Understand principle behind fiber optic communication and the electronic devices involved in the transmission and reception of data.

CO4: Know about basics of properties of matter and its applications,

CO5: Gain knowledge about basic equations of Quantum mechanics and its applications.

CO6: Understand the basic concepts of acoustics and ultrsonics.

SOLID STATE PHYSICS **9**

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Crystal Defects-point, Line and surface defects - burger vector.

WAVE OPTICS **9**

LASERS: Introduction – Principle of Spontaneous emission and stimulated emission. Population inversion, pumping. Einsteins A and B coeffcients – Derivation- Types of lasers – CO_2, Nd-YAG - Industrial Applications - Lasers in welding, cutting and Soldering

FIBER OPTICS: Optical Fiber-Classification- Principle and propagation of light in optical fibres-Numerical aperture and Acceptance angle-Fibre optical communication system- Sensors (Active and passive) –Displacement and Temperature Sensors.

PROP ERTIES OF MATTER **9**

Elasticity–Stress - strain diagram and its uses -factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple- torsion pendulum: theory and experiment -bending of beams -bending moment –cantilever: theory and experiment–uniform and non-uniform bending: theory and experiment – I shaped girders - stress due to bending in beams.

QUANTUM PHYSICS **9**

Black body radiation – Planck's theory -Photoelectric effect - Matter waves – Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box.

ACOUSTICS AND ULTRASONICS **9**

ACOUSTICS: Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - Sabine's formula - absorption coefficient and its determination – factors affecting acoustics of buildings : focusing, interference, echo, Echelon effect, resonance - noise and their remedies

Ultrasonics: Ultrasonics - production - magnetostriction and piezoelectric methods - acoustic grating - industrial applications - NDT.

Total Periods45

Text books:

1. Gaur R. K., Gupta S. C., "Engineering Physics" Dhanpat Rai Publications, New Delhi (2016)
2. Avadhanulu M. N., Kshirsagar, P. G., "A Text book of Engineering Physics", S.Chand and company, Ltd., New Delhi, 2017.

References:

1. Serway and Jewett., "Physics for Scientists and Engineers with Modern Physics",6th Edition, Thomson Brooks/Cole, Indian reprint (2016)
2. Arither Beiser, Concepts of Modern Physics, Tata Mc Graw Hill, NewDelhi (2015)

191HS14	**ENGINEERING CHEMISTRY**	**L-T-P**	**C**
		2-0-0	**2**

Programme: **B.E./B.Tech. (Common to all Branches)** **Sem:** **1** **Category:** BSC

Prerequisites: Basic Science

Aim: To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

Course Outcomes:

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

CO1: Demonstrate the essential concept of water and their properties and applications.
CO2: The treatment of water for potable and industrial purposes
CO3: Understand the operating principles and the reaction involved in electrochemistry.
CO4: Know the principles and application of spectroscopy
CO5: Learn the basic ingredients required for paint formulation
CO6: Know the preparation techniques of consumer products

WATER TECHNOLOGY **9**

Hardness-Types and Estimation by EDTA method- alkalinity –types of alkalinity and determination -Domestic water treatment –disinfection methods – Boiler feed water– internal conditioning– external conditioning – desalination and reverse osmosis.

ELECTROCHEMISTRY **9**

Electrochemical cells – reversible and irreversible cells – EMF –measurement of emf – Single electrode potential – Nernst equation– reference electrodes –Standard Hydrogen electrode – Calomel electrode – Ion selective electrode – glass electrode and measurement of pH – electrochemical series

SPECTROSCOPIC TECHNIQUES AND APPLICATIONS **9**

Introduction of UV-Visible and IR spectroscopy and selection rules- principles and instrumentation of UV-Visible (electronic) spectroscopy – IR (vibrational) spectroscopy - its applications. Fluorescence spectroscopy and its applications in medicine-colorimetry – estimation of iron by colorimetry .

INORGANIC&ORGANIC COATINGS **9**

Paint–Definition–Components of Paints and their functions–Varnish–Definition–Preparation of Oil Varnish–Differences between Paint and Varnish–Special Paints–Luminescent Paints, Fire Retardant Paints- Aluminium Paints - Distemper.corrosion control– electroplating (Au) and electroless (Ni) plating.

PREPARATION OF CONSUMER PRODUCTS **9**

Washing Powder- Cleaning powder-phenoyls (white, Black & coloured)-Shampoo-liquid blue-inks-blue –red-green inks – Soap - bathing & detergent – oils-Face powder and bleaching powder.

Total Periods: 45

Text books:

1. P. Kannan, A. Ravikrishnan, “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009.

2. P.C.Jain and Monica Jain, “Engineering Chemistry” Dhanpat Rai Pub, Co., New Delhi (2002)

References:

1. S.S. Dara, S.S. Umare, “Engineering Chemistry”, S. Chand & Company Ltd., New Delhi 2010.
2. B.K.Sharma, “Engineering chemistry” Krishna Prakasan Media (P) Ltd., Meerut (2001).
3. B.Sivasankar, “Engineering chemistry” Tata McGraw Hill Publishing Company (P) Ltd., New Delhi, 2006

191EEF1	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**	**L-T-P**	**C**
		3-0-0	**3**

Programme	B.E –Electrical and Electronics Engineering	**Sem:**	**1**	**ES**
			Category	

AIM: To provide comprehensive idea about AC and D C circuit analysis, working principles and applications of basic machines in electrical engineering and protection schemes in power system.

Pre-requisite: Algebra, calculus and electrostatics

Course Outcomes:

The Students will be able to

CO1. Analyze DC circuits using basic laws.

CO2. Analyze AC circuits using basic laws.

CO3. Understand the operation of DC machines and its applications.

CO4. Demonstrate about AC machines and its applications.

CO5. Analyze and compare the construction, theory and characteristics of the semiconductor devices.

CO6. Design basic combinational and sequential logic circuits.

ELECTRICAL CIRCUITS & MEASUREMENTS **12**

Ohm's Law – Kirchhoff's Laws –Reduction of series and parallel circuits-Mesh and Nodal Analysis of DC circuits – Introduction to AC Circuits - RMS Value, Average value, Form factor and peak factor phasor representation – Single Phase AC series circuits with R, RL, RC -Power and Power factor. Introduction to three phase circuits- Star and delta connected balanced load.

DC MACHINES & TRANSFORMER (Qualitative treatment only) **8**

DC Generators - construction, principle of operation, Types, EMF equations and applications. DC Motors - operation, Types, Speed and torque equation – speed control of DC shunt motors. Single Phase Transformer - Constructional details and operation, Types, EMF equation, transformation ratio.

AC MACHINES (Qualitative treatment only) **8**

Single phase induction motor - construction, operation and applications - Three phase induction motor – Types, Construction and operation, Torque equation, slip torque characteristics, Synchronous generators - construction and operation, EMF equation - Synchronous motors – principle of operation.

SEMICONDUCTOR DEVICES (Qualitative treatment only) **9**

Introduction to semiconductors-PN Junction Diode – characteristics, breakdown effect and applications - Half wave and Full wave rectifiers, Zener Diode - characteristics and voltage regulator. Bipolar Junction Transistor – operation of NPN and PNP, characteristics of CB, CE, CC configurations.

DIGITAL ELECTRONICS (Qualitative treatment only) **8**

Number System – Binary, octal, hexadecimal, Logic Gates (AND, OR,NOT,NAND,NOR,XOR,XNOR), Half and Full Adders – Flip-Flops –RS, JK, T and D - Counters – synchronous up counter, synchronous down counter, asynchronous up counter, asynchronous down counter, shift registers – shift right and shift left register

Total Periods **45**

Text Books

1. Muthusubramanian R, Salivahanan S, "Basic Electrical, Electronics and Computer Engineering", McGraw Hill, New Delhi, 2009.
2. B L Theraja, AK Theraja,'A Text book of Electrical Technology: Volume 2 AC and DC Machines', S.Chand; Twenty Third edition, 2006.

3. R.S. Sedha, “A Textbook of Applied Electronics” S. Chand & Co., 2008.

References

1. V N Mittle, Arvind Mittle “Basic Electrical Engineering”, McGraw Hill, New Delhi, 2005.
2. Nagsarkar T K and Sukhija M S, “Basics of Electrical Engineering”, Oxford University press (2012).
3. V K Mehta, Rohitmehta “Principles of Electronics”, S.Chand& Company Ltd, (2015).
4. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series, McGraw Hill, (2014).
5. NPTEL Video Lecture Notes on “Basic Electronics “ by Prof. M.B Patil, IIT Bombay

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	1							3		3		1	3
CO2	3	3	3			1					3		3		1	3
CO3	3	2									2		3	3		3
CO4	3	2									2		3	3		3
CO5	3	2				1					3		3	2		3
CO6	3	3	3			1					3		3	2		3

191MEF1 ENGINEERING GRAPHICS L-T-P C

				1-0-4	**3**
Programme:	**B.E. ,(ECE, CSE, BME)**	**Sem:**	**I**	**Category:**	**ESC**

Prerequisites: Nil

Aim: To develop graphic skills in students

Course Outcomes:

The students will be able to

CO1:Follow the conventions used in engineering graphics

CO2:Practice plane curves and free hand sketching

CO3:Draw the projections of points, lines and plane

CO4:Draw the projections of simple solids and their sectional views

CO5:Describe the applications of development of surfaces

CO6:Practice isometric and perspective projections

Concepts and conventions (Not for Examination)

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

PLANE CURVES **11**

Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – Construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

PROJECTION OF POINTS, LINES AND PLANE SURFACES **12**

Projection of Points in all four quadrants - Projection of straight lines located in the first quadrant – inclined to both planes – Determination of true lengths and true inclinations – Projection of regular polygonal and circular lamina inclined to both reference planes.

PROJECTION OF SOLIDS **12**

Projection of simple solids like Prisms, Pyramids, Cylinder and Cone when the axis is inclined to one reference plane

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES **12**

Sectioning of above solids in simple vertical position by cutting planes inclined to HP and perpendicular to VP – Obtaining true shape of section; Development of lateral surfaces of truncated solids – Prisms, Pyramids, Cylinder and Cone

ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS **12**

Principles of isometric projection – isometric scale – isometric projections of truncated Prisms, Pyramids, Cylinder and Cone; Conversion of Isometric Views to Orthographic Views and Vice-versa.

Total Periods: 60

Text books:

1. Natrajan K.V., **"A text book of Engineering Graphics",** Dhanalakshmi Publishers, Chennai (2015)

2. Basant Agarwal and Agarwal C.M., **"Engineering Drawing",** Tata McGraw Hill Publishing Company Limited, New Delhi, (2016)

References:

1. Venugopal K. and Prabhu Raja V., **"Engineering Graphics",** New Age International (P) Limited (2016)

2. Shah M.B. and RanaB.C., **"Engineering Drawing",** Pearson Education (2009)

3. John K.C., **"Engineering Graphics for degree"** PHI Learning Pvt. Ltd., New Delhi, (2015)
4. KumarM.S., **"Engineering Graphics",** D.D. Publications, (2015)

191HS17	**PHYSICS AND CHEMISTRY LABORATORY-I**	**L-T-P**	**C**
		0-0-2	**1**

Programme:	**B.E./B.Tech. (Common to all Branches)**	**Sem:**	**1**	**Category:**	**BSC**
Pre/Corequisites:	Engineering Physics & Engineering Chemistry				
AIM:	To introduce the basic Physics concepts through experiments and to impart the basic analysis in chemistry.				

Course Outcomes:

The Students will be able to

CO1:Understand the laser light propagation in optical fibre and the rigidity modulus of the materials
CO2: Understand the velocity of sound in liquid and propagation light in the medium
CO3: know about the stress analysis and thermal conductivity of the material
CO4: Gain knowledge of water quality parameter of potable water
CO5: Determine the unknown concentrations of chemicals
CO6: Apply the instrumental technique for calculating the amount of unknown substance

LIST OF EXPERIMENTS - PHYSICS PART

(A minimum of five experiments shall be offered)

S.No	NAME OF THE EXPERIMENT	
1)	(a) Determination of Particle Size using Diode LASER. (b) Determination of wavelength of the LASER source. (c) Determination of Acceptance angle and Numerical aperture ofan optical fibre.	3
2)	Torsional pendulum – Determination of rigidity modulus	3
3)	Determination of Velocity of sound and compressibility of liquid - Ultrasonic Interferometer.	3
4)	Determination of Dispersive power of a prism using Spectrometer.	3
5)	Determination of Young's modulus of the material - Non uniform bending	3
6)	Determination of thermal conductivity of a bad conductor - Lee's Disc method	3

LIST OF EXPERIMENTS – CHEMISTRY PART

S.No	NAME OF THE EXPERIMENT	
1)	Estimation of Total Hardness of their home town Water by EDTA method.	3
2)	Estimation of Alkalinity of Water sample	3
3)	Estimation of Chloride ion in water sample by Argentometric method.	3
4)	Estimation of Ferrous Ion by Potentiometric Titrations.	3
5)	Conductometric Titration of strong acid Vs strong base	3

References

1) Text book of Quantitative Inorganic Analysis, A.I.Vogel, ELBS,London,(2006)
2) "Practical A. Ravikrishnan Engineering Chemistry", Sri Krishna Publications, Chennai (2002)
3) Engineering Physics Laboratory Manual
4) Engineering Chemistry Laboratory Manual

191EEF7 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY **L-T-P C**

0-0-2 1

Programme: B.E. Electronics and Communication Engineering **Sem: 1 Category: ESC**

AIM: To expose the students to basic laws, characteristics of diodes, operation of D.C and A.C machines and give them experimental skill.

Course Outcomes:

The Students will be able to

CO1. Facilitate the operation of fluorescent lamp, staircase wiring and simple wiring

CO2: Apply the circuit theory concepts and analyze the outcome.

CO3: Illustrate the VI characteristics of PN diode

CO4: Examine the V-I characteristics of a Zener diode

CO5: Obtain various characteristics of DC Machines.

CO6: Model and analyze the performance characteristics of induction motors.

LIST OF EXPERIMENTS

1. Simple wiring connection
2. Staircase wiring
3. Fluorescent lamp wiring
4. Study of electronic components and equipments
5. Verifications of ohm's law and kirchoff's voltage law
6. Characteristics of semiconductor diode
7. Characteristics of zener diode
8. Speed control of dc shunt motor
9. Load test on dc shunt motor
10. Load test on single phase induction motor

Total Periods 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	1				3		3		3	2	2	2
CO2	3	2		2	1				3		2		3	2		2
CO3	3	2		2	1				3		2		3	2		3
CO4	3	3	2	2	1				3		2		3	2		3
CO5	3	2		2	1				3		3		3	2	1	2
CO6	3	2		2	1				3		3		3	2	1	2

191HS21 TECHNICAL ENGLISH **L-T-P C**

2-0-0 2

Programme: **B.E./B.Tech. (Common to all Branches)** **Sem:** **2** **Category:** **HSMC**

Prerequisites: Acquire Proficiency in Technical Communication

Aim: To develop the students' intellectual, personal & Professional abilities.

Course Outcomes:

The Students will be able to

CO1: Remember words and its meanings for the specific purpose.
CO2: Understand the basic nuances of language
CO3: Apply written communication methodologies at workplace.
CO4: Develop Listening skill to respond and to gather information.
CO5: Interpret the text using comprehending skill.
CO6: Involve in professional correspondences confidently.

UNIT I Introduction to Technical English **9**

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises. **Speaking** – Asking for and giving directions. **Reading** – reading short technical texts, Newspapers. **Writing** - Purpose statements, Extended definitions, Writing Instructions & Recommendations, Checklists. **Vocabulary Development** - Technical Vocabulary. **Language Development** – Subject Verb Agreement.

UNIT II Reading and Study Skills **9**

Listening - Listening to longer technical talks and completing exercises based on them. **Speaking** – Describing a process. **Reading** – Reading longer technical texts, News papers identifying various transitions in a text- paragraphing. **Writing** - Techniques for writing Precisely. **Vocabulary Development** -vocabulary used in formal letters/emails and reports. **Language Development** - Personal & Impersonal Passive voice, Numerical adjectives.

UNIT III Technical Writing and Grammar **9**

Listening - Listening to classroom lectures on Engineering / Technology. **Speaking** – Introduction to Technical presentations. **Reading** – Reading longer texts both general and Technical, practice in rapid reading. **Writing**- Describing a process, Use of sequence words, Causes and Effects **Vocabulary Development** - Sequence words, Nominal compounds, Misspelled words. **Language Development** - Embedded sentences.

UNIT IV Report Writing **9**

Listening- Listening to documentaries and Making notes. **Speaking** – Mechanics of presentations. **Reading** – Reading for detailed comprehension. **Writing** - Job application, cover letter, Resume preparation. **Vocabulary Development** - Finding suitable synonyms, Paraphrasing. **Language Development** – Clauses, If conditionals.

UNIT V Group Discussion and Job Applications **9**

Listening - TED/Ink talks. **Speaking** – Participating in a Group discussion. **Reading** – Reading and Understanding Technical articles. **Writing** – Writing reports, Minutes of Meeting, Introduction and

Conclusion. **Vocabulary Development** - Verbal analogies**. Language Development** - Reported speech.

Total Periods: 45

Text books:

1. Sudharshana,N.P. and C.Savitha. English for Technical Communication. New Delhi: Oxford University Press, 2017.

References:

1. **www.bbc.co.uk/learning english**
2. **www.bec cambridge english.**org
3. **www.englishenglish101.com**
4. **www.islcollective.com**

Extensive Reading

1. Kalam, Abdul. *The Wings of Fire*. Hyderabad: UP, 1999. Print.

191HS22	DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS	L-T-P	C
		3-2-0	4

Programme: **B.E./B.Tech. (Common to all branches)** **Sem:** **2** **Category:** **BSC**

Prerequisites: Engineering Mathematics-I

Aim: To analyze the engineering problems using the techniques and the mathematical skills acquired by studying ODE and PDE uses numerical methods.

Course Outcomes:

The students will be able to

CO1: Use suitable method to solve higher order Differential Equations

CO2: Use suitable method to solve higher order PDE

CO3: Interpolate discrete data by means of continuous function.

CO4: Discover Numerical integration using Trapezoidal and Simpson's 1/3rd rules

CO5: Find the solution for the IVPs in ODE using single step and Multistep methods

CO6: Find the solution of BVPs in PDE using finite difference methods

ORDINARY DIFFERENTIAL EQUATIONS **12**

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

PARTIALDIFFERENTIALEQUATIONS **12**

Formationofpartialdifferentialequations–Lagrange'slinearequation–Solutionsof standard typesoffirstorderpartialdifferentialequations (without reducing the standard type) –Linear homogenouspartialdifferential equationsofsecondandhigher order withconstantcoefficients.

SOLUTION OF EQUATION & INTERPOLATION, NUMERICAL DIFFERENTIATION **12**

Solutions of Polynomial and transcendental equations – Newton Raphson method - Interpolation using Newton's forward and backward difference formulae - Interpolation with unequal intervals- Newton's divided difference and Lagrange's formulae - Numerical differentiation using Newton's forward and backward difference formula - Numerical Integration – Trapezoidal rule and Simpson's 1/3rd rule..

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **12**

Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method – Milne's predictor – corrector methods for solving first order equations – Finite difference methods for solving second order equation.

BOUNDARY VALUE PROBLEMS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Finite differences solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

Total Periods: **60**

Text books:

1. B.S. Grewal, 'Higher Engineering Mathematics', Thirty Sixth Edition, Khanna Publishers, Delhi, 2005.

2. Grewal B.S. and Grewal J. S., "Numerical Methods in Engineering and Science", Khanna Publishers, New Delhi, (2004).

References:

1. Greenberg. *M.D*. "Advanced Engineering Mathematics, Second Edition, Pearson Education Inc. (First Indian reprint), 2002
2. Venkataraman. M.K., "Engineering Mathematics", Volume I and II Revised enlarged Fourth Edition, The National Publishing Company, Chennai, 2004.
3. Kreyszig, E., Advanced Engineering Mathematics, 8th edition, John Wiley Sons, 2001.
4. Chapra S.C. and Canale R.P., "Numerical Methods for Engineers", Tata Mc-Graw Hill, New Delhi, (2007).
5. Gerald C.F., and Wheatley P.O., "Applied Numerical Analysis", Pearson Education Asia, New Delhi, (2006).

191HS23	**PHYSICS OF MATERIALS**	**L-T-P**	**C**
		2-0-0	**2**

Programme: **B.E., (CSE, EEE,ECE & Bio Medical)** **Sem: 2** **Category: BSC**

Prerequisites: Engineering Physics

AIM: To endow the students with the fundamentals of physics, materials and apply new ideas in the field of Engineering and Technology.

Course Outcomes:

The Students will be able to

CO1: Understand the theory and processing of conducting, superconducting materials.
CO2: Acquire knowledge of classification of semi conducting materials.
CO3: Gain knowledge about the types of magnetic materials and their applications.
CO4: Enhance the knowledge about dielectric materials and their applications
CO5: Understanding on the functioning of optical materials for optoelectronics.
CO6: Know about the basics of quantum structures and their applications in spintronics

ELECTRICAL PROPERTIES OF MATERIALS **9**

Conductors: classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory –Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

Super Conductors: properties - Types of super conductors - Applications of superconductors – SQUID, cryotron, magnetic levitation.

SEMICONDUCTOR PHYSICS **9**

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – Extrinsic semiconductors – carrier concentration derivation in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration– Hall effect – Determination of Hall coefficient – Applications.

MAGNETIC AND DIELECTRIC MATERIALS **9**

Magnetic Materials: Origin of magnetic moment – Bohr magneton – Dia and para magnetism – Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti – ferromagnetic materials – Ferrites – applications.

Dielectric Materials: Polarization - electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation –dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

OPTICAL PROPERTIES OF MATERIALS **9**

Classification of optical materials–carrier generation and recombination processes-Absorption - emission and scattering of light in metals, insulators and Semiconductors (concepts only)-photocurrent in a P-N diode–solar cell–photo detectors-LED-optical storage techniques

NANOELECTRONIC DEVICES **9**

Introduction-electron density in bulk material–Size dependence of Fermi energy–quantum confinement–quantum structures-Density of states in quantum well, quantum wire and quantum dot structures – Zener-Bloch oscillations–resonant tunneling – Carbon nanotubes: Properties and applications.

Total Periods 45

Text books:

1. William D. Callister, Jr., **"Material Science and Engineering",** John Wiley & Sons Inc., Seventh Edition, New Delhi (2017).
2. Ragavan, V., **"Material science and Engineering"**, Prentice Hall of India (2004).
3. Kasap, S.O. **"Principles of Electronic Materials and Devices**", McGraw -Hill Education, 2016.

4. Umesh K Mishra & Jasprit Singh, "**Semiconductor Device Physics and Design**", Springer, 2014.

References:

1. Koch C., **"Nanostructured materials: processing, properties and applications",** William Andrew pub. (2011).
2. Charles P. Poole and Frank J.Ownen., **"Introduction to Nanotechnology"**, Wiley India (2016)
3. Charles Kittel., **"Introduction to solid state Physics"**, John Wiley & Sons, 7th editions, Singapore (2012)

191HS24	**ENVIRONMENTAL SCIENCE**	**L-T-P**	**C**
		2-0-0	**2**

Programme:	**B.E./B.Tech. (Common to all branches)**	**Sem:**	II	**Category:**	BSC

Prerequisites: Basic Science

Aim: To Impart the social groups and individuals to acquire knowledge of pollution and environmental degradation

Course Outcomes: The student will be able to

CO1: Understand the basic concepts of environment and energy resources

CO2: Get knowledge about the ecosystem

CO3: Identify and analyze causes, effects and control measures of various types of pollution.

CO4: Get the knowledge about types of disaster and mitigation measures

CO5 : Understand the impact of social issues and climate change

CO6: Understand to create the green environment.

ENVIRONMENT AND ENERGY RESOURCES **9**

Environment- definition, scope and importance – Need for public awareness – Forest resources-deforestation–Energy resources: Growing energy needs, renewable (solar energy and wind energy) and non renewable energy sources-Nuclear energy – fission and fusion reactions and light water nuclear reactor for power generation (block diagram only), Petroleum processing and fractions

ECOSYSTEM **9**

ECOSYSTEM : Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Energy flow in the ecosystem-Nitrogen cycle,Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the Forest ecosystem and Aquatic ecosystems (lake and rivers)

ENVIRONMENTAL POLLUTION **9**

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Marine pollution (d) Noise pollution . Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution –Disaster management: floods- landslides.

SOCIAL ISSUES AND EARTH'S CLIMATE SYSTEM **9**

Population-variation among nation-Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting– climate change, global warming, acid rain, Ozone layer depletion.

GREEN CHEMISTRY **9**

Introduction to green chemistry- 12 principles of green chemistry-toxicology and green chemistry-energy and green chemistry-education in green chemistry. Reuse and recycling technologies-material selection for green design-recycled water technology.

Total Periods: 45

Text books:

1. A. Ravikrishnan, "Environmental Science and Engineering, Sri Krishna Hitech Publishing Company Private Limited, 2010.
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.

References:

1. Anubha Kaushik, C.P. Kaushik, "Environmental Science and Engineering", New Age International Publishers, 2016.
2. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill Publishing Company Ltd, New Delhi, ISBN: 0070601690, 2006.
3. Raman Sivakumar, *Introduction to Environmental Science and Engineering*, Tata McGraw HillEducation Private Limited, New Del2010.

4. P.Meenakshi, Elements of Environmental Science and Engineering, PHI learning (P) Ltd., India.

191CSF1	PROGRAMMING FOR PROBLEM SOLVING	L-T-P	C
		3-0-0	3

Programme: **B.E., (ECE,CSE,BME)** **Sem: 2** **Category: ESC**

Prerequisites: Nil

Aim: To provide an awareness to Computing and Programming.

Course Outcomes:

The students will be able to

CO1: Understand the basic terminologies of Computer and various Problem solving techniques.

CO2: Write, compile and debug programs in C language.

CO3: Use different data types in a computer program.

CO4: Design programs involving decision structures, loops and functions.

CO5: Understand the dynamics of memory by the use of pointers.

CO6:Use different data structures and create/update basic data files.

INTRODUCTION **9**

Generation and Classification of Computers- Basic Organization of a Computer - Number System - Binary - Decimal - Conversion - Problems. Software - Types, Development Steps. Algorithm - Pseudo code - Flow Chart. Problem formulation - Problem Solving.

C PROGRAMMING BASICS **9**

Introduction to Unix Operating System - Introduction to ' C' programming - fundamentals - structure of a 'C' program - compilation and linking processes - Constants, Variables - Data Types - Expressions using operators in 'C' - Managing Input and Output operations - Decision Making and Branching - Looping statements - solving simple scientific and statistical problems.

ARRAYS AND STRINGS **9**

Arrays - Initialization - Declaration - One dimensional and Two dimensional arrays. String- String operations - String Arrays. Simple programs –Bubble Sort – Linear Search -Matrix Operations.

FUNCTIONS AND POINTERS **9**

Function - Definition of function - Declaration of function - Pass by value - Pass by reference - Recursion - Pointers - Definition - Initialization - Pointers arithmetic - Pointers and arrays- Example Problems.

STRUCTURES AND FILES **9**

Introduction - need for structure data type - structure definition - Structure declaration - Structure within a structure - Union - Programs using structures and Unions - File Manipulation - Storage classes - Pre-processor directives.

Total Periods 45

Text books:

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2017.
2. Balagurusamy E, "Programming in ANSI C", Tata Mcgraw-Hill Education, 2016
3. ReemaThareja, "Computer Fundamentals and Programming in C", 2e, Oxford University Press, 2016.

References:

1. Byron S Gottfried, "Programming with C", Schaum's Outlines, 3rd Edition, McGraw-Hill, 2017.

2. Dromey R.G., “How to Solve it by Computer”, Pearson Education, 4th Reprint, 2007.
3. Kernighan.B.W and Ritchie,D.M, “The C Programming language”, 2nd Edition, Pearson Education, 2006.

191ME17	MECHANICAL WORKSHOP	L-T-P	C
		1-0-4	3

Programme:	**B.E., (ECE,CSE,BME)**	**Sem:**	**2**	**Category:**	**ESC**

Prerequisites: Nil

Aim: To Provide exposure to the students with hands on experience on various basic Engineering Practices

Course Outcomes:

The students will be able to

CO1: Make the square fitting, vee & step fitting
CO2: Produce simple wooden joints using wood working tools
CO3: Fabricate tray and funnel in sheet metal
CO4: Create simple lap, butt and tee joints using arc welding equipments
CO5: Identify the various pipe joints
CO6: Make the pipe connections

FITTING OPERATIONS & POWER TOOLS **12**

Preparation of square fitting, vee & step – fitting models

CARPENTRY **12**

Study of the joints in roofs, doors, windows and furniture; Hands-on-exercise: Dismantling & Assembling of various wooden furniture; Preparation of T Joint, dove tail joint

SHEET METAL FORMING **12**

Preparation of tray and funnel

WELDING **12**

Preparation of arc welding of butt joints and lap joints

PLUMBING **12**

Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings; Hands-on-exercise - basic pipe connections – Mixed pipe material connection – Connections with different joining components

Total Periods: 60

LIST OF EQUIPMENTS (For a batch of 30 students)

1. Fitting vice (fitted to work bench) - 15Nos
2. Fitting Tools – 15 set
3. Carpentry vice (fitted to work bench) - 15 Nos.
4. Models of industrial trusses, door joints, furniture joints - 5 Nos.
5. Standard woodworking tools - 15 Sets
6. Hand Shear - 01
7. Standard tools and calipers for sheet metal work - 05
8. Arc welding transformer with cables and holders - 5Nos.
9. Welding booth - 5 Nos.
10. Welding accessories like welding shield, chipping hammer, Wire brush, etc., - 5Sets
11. Assorted components for plumbing consisting of metallic pipes, Plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings - 15 Sets.

191HS27	**PHYSICS AND CHEMISTRY LABORATORY-II**	**L-T-P**	**C**
		0-0-2	**1**

Programme:	B.E/B.Tech (Common to all Branches)	**Sem:**	**2**	**Category:**	**BSC**
Pre/Corequisites:	Engineering Physics & Engineering Chemistry				
AIM:	To introduce the basic Physics concepts through experiments and to impart knowledge on the application of chemistry in engineering branches.				

Course Outcomes:

The Students will be able to

CO1: Learn the interference of light and young's modulus of the materials
CO2: Understand the properties of flow of the liquid.
CO3: Know the band gap of material and resistance of the given coil.
CO4: Determine the quantity of unknown solution by instrumental technique.
CO5: Determine the concentration of an identified analyte by volumetric analysis
CO6: Analyze the characteristics of water.

LIST OF EXPERIMENTS - PHYSICS PART

(A minimum of five experiments shall be offered)

S.No	**NAME OF THE EXPERIMENT**	
1)	Determination of thickness of thin wire – Air wedge method	3
2)	Determination of Young's modulus of the material – Uniform bending	3
3)	Determination of viscosity of liquid – Poiseuille's method.	3
4)	Determination of wavelength of mercury spectrum- Spectrometer Grating.	3
5)	Determination of Band Gap of a semiconductor material.	3
6)	Determination of specific resistance of a given coil of wire – Carey Foster Bridge.	3

LIST OF EXPERIMENTS – CHEMISTRY PART

S.No	**NAME OF THE EXPERIMENT**	
1)	Esimation of HCl by pH metry	3
2)	Estimation of Copper in brass by EDTA method.	3
3)	Estimation of iodine in iodized salt with thiosulfate	3
4)	Determination of percentage of calcium in limestone by EDTA method	3
5)	Determination of DO in water (Winkler's method)	3

References

1) Text book of Quantitative Inorganic Analysis, A.I.Vogel, ELBS,London, (2006).
2) "Practical A. RaviKrishnan Engineering Chemistry", Sri Krishna Publications, Chennai (2002)
3) Engineering Physics Laboratory Manual
4) Engineering Chemistry Laboratory Manual

191CS17	C PROGRAMMING LABORATORY	L-T-P	C
		0-0-2	1

Programme: B.E.,**(ECE,CSE,BME)** **Sem:** 2 **Category:** ESC

Pre/Corequisites: Nil

AIM: To provide practical knowledge in developing C Programming.

Course Outcomes:

The Students will be able to

CO1: Able to have fundamental concept on basics commands in Linux.

CO2: Able to write,compileand debug programs in C language.

CO3: Able to formulate problems and implement algorithms in C.

CO4: Able to effectively choose programming components that efficiently solve computing problems in real-world.

CO5: Able to design application oriented programs in C.

CO6: Structures and unions through which derived data types can be formed..

LIST OF EXPERIMENTS:

1. Draw a flowchart for various algorithms using Raptor
2. C Programming using Simple statements and expressions.
3. Scientific problem solving using decision making and looping.
4. Simple programming for one dimensional and two dimensional arrays.
5. Solving problems using String functions.
6. Programs with user defined functions - Includes Parameter Passing.
7. Program using Recursive Function and conversion from given program to flow chart.
8. Programs using pointers
9. Program using structures and unions.
10. Program using files.

Total Periods 60

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Standalone desktops with C compiler 30 Nos.

(or)

Server with C compiler supporting 30 terminals or more.

191HS31	TRANSFORMS AND DISCRETE MATHEMATICS	L-T-P	C
		2-2-0	3

Programme: **B.E./B.Tech. (Common to all branches)** **Sem: III** **Category: BSC**

Aim: To introduce basic mathematical ideas such as reasoning techniques, basic counting techniques and their applications .

Course Outcomes:

The students will be able to

CO1: Apply Laplace transform to solve first and second order differential equations with elementary function.

CO2:Explain the Fourier transform and with their properties.

CO3: Determine Z-inverse transform using convolution theorem and partial fraction method.

CO4:Apply mathematical induction and prove a relation.

CO5: Invent Eulerian and Hamiltonian paths to find shortest paths

CO6: Make use of graph theoretic models to solve basic problems in networks.

LAPLACE TRANSFORMS **9**

Laplace transform —Properties of Laplace Transforms – Laplace Transform of periodic functions –Inverse Laplace transforms by partial fraction method and Convolution theorem (excluding proof) – Solving ODE using Laplace transformation techniques.

FOURIER TRANSFORMS **9**

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosinetransforms–Properties– Transformsofsimplefunctions–Convolutiontheorem –Parseval'sidentity.

Z-TRANSFORMS **9**

Z-transforms–Elementaryproperties–InverseZ-transform–Convolutiontheorem– Formationofdifferenceequations– SolutionofdifferenceequationsusingZ-transform.

INTRODUCTION TO COUNTING **9**

Decision problems on Propositional logic – Basic counting techniques – inclusion & exclusion-Pigeonhole principle – Permutations and combinations-Recurrence relations-Solving Linear recurrence relationsandgenerating functions

INTRODUCTION TO GRAPHS **9**

Graphs andtheir basic properties– Graph terminology and special types of graphs - Representing graphs and graph isomorphism – Euler and Hamilton paths.

Total Periods: 45

Text Book

1. B.S.Grewal, 'Higher Engineering Mathematics', Thirty Sixth Edition, Khanna Publishers, Delhi, 2005.
2. Grewal B.S. and Grewal J. S., "Numerical Methods in Engineering and Science", Khanna Publishers, New Delhi, (2004).

Reference

1. Greenberg. *M.D*. "Advanced Engineering Mathematics, Second Edition, Pearson Education Inc. (First Indian reprint), 2002
2. Venkataraman.M.K., "Engineering Mathematics", Volume I and II Revised enlarged FourthEdition, The National Publishing Company, Chennai, 2004.
3. Trembly J. P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw–Hill Pub. Co. Ltd, NewDelhi, 30th Re-print (2007).

4Dr.P.Kandasamy,Dr.K.Thilagavathy,Dr.K.Gunavathy,**"Transforms and Partial Differential Equation",** S.Chand& Company Ltd. Ram Nagar,New Delhi.

91EC31	**CIRCUITS AND ELECTRONIC DEVICES**	**L-T-P**	**C**
		3-2-0	**4**

Programme: B.E. - Electronics and Communication Engineering **Sem: 3 Category: PC**

Aim: To enable the students to develop skills in identifying and testing electronic components and designing circuits using BJT and FET.

Course Outcomes: The students will be able to

CO1: Adept at using various methods of circuit's analysis, including simplified methods such as series parallel reductions, voltage and current dividers.

CO2: Appreciate the consequences of linearity, in particular the principle of superposition, Thevenin and Norton equivalent circuits.

CO3: Analyze the transient responses of RL, RCand RLC circuits.

CO4: Compare and contrast the characteristics of different solid-state devices and relate them to appropriate application

CO5: Demonstrate the internal workings of the special semiconductor diodes

CO6: Analyze different types of diodes and their schematic symbols.

BASIC LAWS AND NETWORKS THEOREMS **12**

Kirchoff's laws – series and parallel connection of independent sources – R, L and C – Network Theorems – Thevenin, Superposition, Norton, Maximum power transfer and duality – Star-delta conversion

TRANSIENT RESONANCE IN RLC CIRCUITS **12**

Basic RL, RC and RLC circuits and their responses to pulse and sinusoidal inputs – frequency response – Parallel and series resonances – Q factor – single tuned and double tuned circuits.

12

BIPOLAR JUNCTION TRANSISTORS

NPN and PNP Transistor-Configuration-I/O Characteristics of CE,CB and CC Configurations -h-Parameters for CE configuration-Comparison of CE ,CB and CC configurations-Bias Stability-Need for biasing-Fixed bias-Self bias-Stability factor-Bias Compensation

12

FIELD EFFECT TRANSISTORS

Construction and Operations of JFET -Drain and Transfer Characteristics-Parameters of JFET-Saturation Drain Current -Slope of the Transfer Characteristics at IDSS-Comparison of JFET and BJT-Construction and Operation of MOSFET-Depletion Type and Enhancement Type -Comparison of MOSFET with JFET-Biasing of FET and MOSFET-Charge Coupled Devices(CCD).

12

SPECIAL SEMICONDUCTOR DEVICES

Tunnel diodes – PIN diode, varactor diode – SCR characteristics and two transistor equivalent model – UJT – Diac and Triac – Laser, CCD, Photodiode, Phototransistor, LED, LASERs, MISFETs,MESFETs, TFETs, HEMTs.

TOTAL PERIODS 60

Text Book:

1. Joseph A. Edminister, Mahmood, Nahri, "Electric Circuits" – Shaum series,Tata Mc Graw Hill, 2007

References:

1. Nandhitha Das Gupta and Amitava Das Gupta "Semiconductor Devices: Modeling and Technology" Prentice Hall of India Pvt Ltd, 4th edition, 2004.
2. Adel S. Sedra and Kenneth C.Smith, "Microelectronic Circuits", Oxford University Press, 6th edition, 2009.
3. Simon M.Sze and Kwok K.Ng, "Physics of Semiconductor Devices", John wiley& sons, 3rd edition, 2006.

4. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits",Tata McGraw Hill,
   2nd edition, (2008).
5. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5thedition,2008.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2		2						2	3	3		2
CO2	2	3	2	2								2	2	3		2
CO3	3	3	3	2								3	3	3		2
CO4	3	3	2	2	2	2						2	2	3		2
CO5	2	3	2	2	2	2						3	3	3		2
CO6	3	3	2	2	2	2						3	3	3		2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EC32	LINEAR INTEGRATED CIRCUITS			L-T-P	C
				3-0-0	3
Programme:	B.E. Electronics and Communication Engineering	**Sem:**	3	**Category:**	**PC**

AIM: To learn the basic concepts in the design of electronic circuits using linear integrated circuits and their applications in the processing of analog signals.

Course Outcomes: The students will be able to

CO1: Examine the operational amplifier stages and its AC, DC performance characteristics.
CO2: Analyze the applications of operational amplifier.
CO3: Elaborate the concepts of analog multiplier IC and PLL IC.
CO4: Classify and explain the types of digital-to-analog and analog-to-digital converters.
CO5: Apply special function ICs to design different types of waveform generators
CO6: Analyze the astable and monostable operation of timer IC 555.

CIRCUIT CONFIGURATION FOR LINEAR ICs **9**

Advantages of ICs over discrete components –General operational amplifier stages and internal circuit diagrams of IC 741– DC and AC performance characteristics – Slew rate – Open and Closed loop configurations.

APPLICATIONS OF OPERATIONAL AMPLIFIERS **9**

Scale Changer – Adder and Subtractor – Instrumentation amplifier – Phase Shift Circuits – Voltage Follower – V-to-I and I-to-V converters – Peak detector – Clipper and Clamper –Differentiator – Integrator – Comparators – Schmitt trigger –Low-pass, high-pass and band-pass filters.

ANALOG MULTIPLIER ICs AND PLL ICs **9**

Analog Multiplier ICs and its applications — Operation of the basic PLL, Closed loop analysis of PLL, Voltage Controlled Oscillator(VCO), Block diagram of PLL IC 565 and its applications for frequency synthesizing, frequency multiplication and division.

A/D AND D/A CONVERTERS **9**

Analog and Digital Data Conversions, D/A converter – specifications - Weighted resistor type, R-2R Ladder type, Voltage Mode R-2R Ladder and Current-Mode R-2R Ladder types - Sampling Process-High speed sample and hold circuit, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type - Dual Slope type - A/D Converter using Voltage-to-Time Conversion.

WAVEFORM GENERATORS AND SPECIAL FUNCTION ICs **9**

Sine-wave generators, Multivibrators, Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555-GeneralDescription - Monostable and Astable operation of Timer IC 555 – LM317 adjustable voltage regulators.

TOTAL PERIODS 45

TEXT BOOK

1.RoyChoudhry.D, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd.,4thEdition, 2014.

REFERENCES

1. Salivahanan.S &KanchanaBhaskaran.V.S., "Linear Integrated Circuits",3rdEdition, McGraw Hill 2018.
2. Sonde.B.S., "System design using Integrated Circuits" , New Age Pub, 2nd Edition, 2001
3. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 2005.
4. Ramakant.A.Gayakwad, "OP-AMP and Linear Ics", Prentice Hall / PE, 4th edition, 2001.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2								2	2	3		2
CO2	2	2	2									1	2	3	2	2
CO3	3	2	3	2	2	2			1			2	2	3	2	2
CO4	3	2	2		1	1			1			2	2	3		2
CO5	2	2	2	1	1	1			2			2	2	3	2	2
CO6	3	2	2	2	2	1			1			2	2	3	2	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191BM31 **ANATOMY AND HUMAN PHYSIOLOGY** **L T P C**
3 0 0 3

Programme: B.E. Biomedical Engineering **Sem: 3 Category: PC**

Aim: To demonstrate their knowledge of importance of anatomical features and physiology of human systems

Course Outcomes:

The Students will be able to

CO1: Label the basic structure and functions of cell

CO2: identify the functions of respiratory, lymphatic and endocrine systems.

CO3: compile the importance of blood group and its functions.

CO4: Organize the organ of digestive systems.

CO5: Label the structure and function of heart.

CO6: Extend the basic concept of nervous systems and its types.

CELL AND TISSUE STRUCTURE **9**

Structure of Cell – structure and functions of sub organelles – Cell Membrane –Transport of Across Cell Membrane - Action Potential – Cell to Cell Signaling – Cell Division. Types of Specialized tissues – Functions.

SKELETAL, MUSCULAR AND RESPIRATORY SYSTEMS **9**

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

CARDIOVASCULAR AND LYMPHATIC SYSTEMS **9**

Cardiovascular: Components of Blood and functions.- Blood Groups and importance – Structure of Heart – Conducting System of Heart – Properties of Cardiac Muscle - Cardiac Cycle - Heart Beat – Types of Blood vessel – Regulation of Heart rate and Blood pressure.Lymphatic: Parts and Functions of Lymphatic systems – Types of Lymphatic organs and vessels.

NERVOUS AND ENDOCRINE SYSTEMS AND SENSE ORGANS **9**

Nervous: Cells of Nervous systems – Types of Neuron and Synapses – Mechanisms of Nerve impulse – Brain : Parts of Brain – Spinal Cord – Tract and Pathways of Spines – Reflex Mechanism – Classification of Nerves - Autonomic Nervous systems and its functions. Endocrine - Pituitary and thyroid gland, Sense Organs: Eye and Ear.

9

DIGESTIVE AND URINARY SYSTEMS

Digestive: Organs of Digestive system – Digestion and Absorption.Urinary: Structure of Kidney and Nephron – Mechanisms of Urine formation – Regulation of Blood pressure by Urinary System – Urinary reflex.

Total Periods: **45**

Text Books:

1. Prabhjot Kaur. Text Book of Anatomy and Physiology. Lotus Publsihers. 2014
2. Elaine.N. Marieb , ―Essential of Human Anatomy and Physiology‖, Eight Edition, Pearson Education, New Delhi, 200

References:

1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, Fundamentals of Anatomy and Physiology. Pearson Publishers, 2014
2. Gillian Pocock, Christopher D. Richards, The human Body – An introduction for Biomedical and Health Sciences, Oxford University Press, USA, 2013
3. William F.Ganong, ―Review of Medical Physiology‖, 22nd Edition, Mc Graw Hill, New Delhi, 2010
4. Eldra Pearl Solomon, ―Introduction to Human Anatomy and Physiology‖, W.B. Saunders Company, 2015

5. Guyton & Hall, ―Medical Physiology‖, 13th Edition, Elsevier Saunders, 2015.

Course Outcomes	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	3	2				2	1	2	3	3	1	
CO2	3	2	1	2	1	1				2		1	3	3	3	2
CO3	3	1	2	3	2	3	1			1		3	3	2	2	3
CO4	3	2	3	3	3	2				2	1	2	3	3	2	3
CO5	3	1	1	2	3	2				2		2	3	3	2	3
CO6	3	3	2	1	1	3				2		2	3	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191BM37	BIOCHEMISTRY	L	T	P	C
		3	0	0	3

Programme: B.E. Biomedical Engineering **Sem:** 3 **Category:** ESC

Aim: To study structural and functional properties of carbohydrates, proteins, lipids and nucleic acids

Course Outcomes:

The Students will be able to

CO1: Propose the fundamentals of biochemistry

CO2: Know the clinical applications of Biochemistry

CO3: organize the structural and functional properties of carbohydrates, proteins, lipids and nucleic acids

CO4: Identify the classifications of enzymes and its clinical applications.

CO5: Summarize the separations of proteins

CO6: know the clinical applications of electrolytes.

INTRODUCTION TO BIOCHEMISTRY **9**

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

CARBOHYDRATES **9**

Classification of carbohydrates - mono, di, oligo and polysaccharides. Structure, physical and chemical properties of carbohydrates Isomerism, racemisation and mutarotation. Digestion and absorption of carbohydrates. Metabolic pathways and bioenergetics – Glycolysis, glycogenesis, glycogenolysis and its hormonal regulation. TCA cycle and electron transport chain. Oxidative phosphorylation. Biochemical aspect of Diabetes mellitus and Glycogen storage Disease

LIPIDS **9**

Classification of lipids- simple, compound and derived lipids. Nomenclature of fatty acid, physical and chemical properties of fat..Metabolic pathways: synthesis and degradation of fatty acid (beta oxidation), hormonal regulation of fatty acid metabolism, ketogenesis, Biosynthesis of Cholesterol. Disorders of lipid metabolism.

NUCLEIC ACID & PROTEIN **9**

Structure of purines and pyrimidines, nucleoside, nucleotide, DNA act as a genetic material, chargoffs rule. Watson and crick model of DNA. Structure of RNA and its type. Metabolism and Disorder of purines and pyrimidines nucleotide Classification, structure and properties of proteins, structural organization of proteins, classification and properties of amino acids. Separation of protein, Inborn Metabolic error of amino acid metabolism.

ENZYME AND ITS CLINICAL APPLICATION **9**

Classification of enzymes, apoenzyme, coenzyme, holoenzyme and cofactors. Kinetics of enzymes - Michaelis-Menten equation.Factors affecting enzymatic activity: temperature, pH, substrate concentration and enzyme concentration. Inhibitors of enzyme action: Competitive, non-competitive, irreversible. Enzyme: Mode of action, allosteric and covalent regulation. Clinical enzymology. Measurement of enzyme activity and interpretation of units.

Total Periods: **45**

Text Books:

1. RAFI MD ―Text book of biochemistry for Medical Student‖ Second Edition, University Press, 2014.
2. David.W.Martin, Peter.A.Mayes , Victor. W.Rodwell, ―Harper‘s Review of Biochemistry‖, LANGE Medical Publications, 1981.

References:

1. Keith Wilson & John Walker, ―Practical Biochemistry - Principles & Techniques‖, Oxford

University Press, 2009.
2. Pamela.C.Champe & Richard.A.Harvey, ―Lippincott Biochemistry Lippincott‘s Illustrated Reviews‖, Raven publishers,1994.

Course Outcomes	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	1	2	2	3	2		1	1	1	1	3	1	1	
CO2	3	3	1	2	1	1		2	1	2		1	3	3	3	2
CO3	3	2	2	1	2	2	1			1		2	3	2	2	
CO4	3	2	1	1	1	2	2			2	1	1	3	1	2	1
CO5	3	3	1	2	2	3	2		1	1		1	3	2	2	1
CO6	3	3	2	1	1	3		2	1	2		1	3	3	2	

191EC37 CIRCUITS AND DEVICES LABORATORY L-T-P C

0-0-2 1

Programme: B.E. - Electronics and Communication Engineering **Sem: III Category: PC**

Aim: To verify the circuit theorem and study the characteristics of electronic devices.

Course Outcomes: The students will be able to

CO1: Construct the microelectronic circuits.

CO2: Design the diode circuits and single stage BJT and MOSFET amplifier circuits for given specifications.

CO3: Analyze the microelectronic circuits.

CO4: Analyze the characteristics of various types of (LED, PIN, Photo Diode) diodes.

CO5: Simulate the microelectronic circuits using P-Spice software.

CO6: Measure and record the experimental data, analyze the results, and prepare a formal laboratory report.

List of Experiments

1. Construct and Analysis of T, π and impedance Matching Networks using NetworkTheorems.
2. Analysis of Wheatstone-Bridge Circuit.
3. Design and analysis of First order RC and LC Circuits as LPF & HPF.
4. Determination of Q factor of a given LC circuit.
5. Analyze the Device behaviour of Semiconductor Diodes and FETs.
6. Analyze the Device behaviour of Bipolar Junction Transistor
7. Analyze the Device behaviour of FETs.
8. Design and Analysis of Voltage Regulators.
9. Design and analysis of Filters.
10. Analyze the characteristics of LED, LDR, Photo Diode and PIN Diode.

TOTAL PERIODS 45

91BM37 HUMAN PHYSIOLOGY LABORATORY L T P C
0 0 2 1

OBJECTIVES:

- To estimation and quantification of blood cells
- To learnt methods for identification of blood groups
- To estimation of haematological parameters
- To learnt the analysis of visual and hearing test

LIST OF EXPERIMENTS

1. Collection of Blood Samples
2. Identification of Blood groups (Forward and Reverse)
3. Bleeding and Clotting time
4. Estimation of Hemoglobin
5. Total RBC Count
6. Total WBC Count
7. Differential count of Blood cells
8. Estimation of ESR
9. PCV, MCH, MCV, MCHC
10. Hearing test – Tuning fork
11. Visual Activity – Snellen‘s Chart and Jaeger‘s Chart

TOTAL: 30 PERIODS

OUTCOMES: At end of the course, Students would be able to

- Identification and enumeration of blood cells
- Enumeration of haematological parameters
- Analysis of special sensory organs test

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS: Requirement for a batch of 30 students

- Microscope 2 Nos
- Centrifuge Normal 1 No
- Wintrobe‘s tube 2 Nos.
- PCV tube 2 Nos
- Neubaur‘s Chamber 2 Nos.
- Heparinized Syringe 1box
- Haemoglobinometer 1 No
- Blood grouping kit 1 No
- Capillary tubes 1 box
- Ophthalmoscope 1 No
- Tuning fork (256Hz to 512Hz) 5 Nos.
- Microslides 2 packets& Lancet 5 boxes

191HS42 PROBABILITY AND STATISTICS L-T-P C
3-2-0 4

Programme: **B.E. / B.Tech. (CIVIL, CSE, EEE, MECH, BIO-TECH & BIO-MEDICAL)** **Sem: III Category: BSC**

Aim: To analyze the engineering problems using the techniques and the mathematical skills acquired by studying ODE and PDE uses numerical methods.

Course Outcomes:

The students will be able to

CO1: Classify the discrete and continuous random variables.

CO2: Analyze the binomial, Poisson, geometric, uniform, exponential and normal distribution.

CO3: Understanding the Two dimensional Random Variables.

CO4: Analyze the differences between means & standard deviations

CO5: Test the independence of attributes for small samples

CO6: Classify the tests for single variance and equality of variances

PROBABILITY AND RANDOM VARIABLES **12**

Probability spaces – Conditional probability – Bayes rule - Discrete and continuous random variables – Moments - Moment generating functions and their properties.

DISCRETE AND CONTINOUS PROBABILITY DISTRIBUTION **12**

Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and normal distributions – Function of Random Variable

TWO DIMENSIONAL RANDOM VARIBLES **12**

Joint distributions - Marginal and conditional distributions – Covariance - Correlation and Regression - Transformation of random variables - Central limit theorem (for 2-D random variables)

STATISTICS **12**

Curve fitting by the method of least squares – fitting of Straight lines , Second degree parabolas and more general curves – Test of significance – Large sample test for single proportion , difference of proportions, single mean, difference of means and difference of standard deviations.

TESTING OF HYPOTHESIS **12**

Sampling distributions – Testing of hypothesis for mean, variance, proportions and differences using Normal, t, Chi-square and F distributions - Tests for independence of attributes and Goodness of fit.

Total Periods: 60

Text Book

1. B.S. Grewal, 'Higher Engineering Mathematics', Thirty Sixth Edition, Khanna Publishers, Delhi, 2005.

2. Grewal B.S. and Grewal J. S., "Numerical Methods in Engineering and Science", Khanna Publishers, New Delhi, (2004).

Reference

1. Greenberg. *M.D*. "Advanced Engineering Mathematics, Second Edition, Pearson Education Inc.
   (First Indian reprint), 2002
2. Venkataraman. M.K., "Engineering Mathematics", Volume I and II Revised enlarged Fourth Edition, The National Publishing Company, Chennai, 2004.
3. Kreyszig, E., Advanced Engineering Mathematics, 8th edition, John Wiley Sons, 2001.
4. Chapra S.C. and Canale R.P., "Numerical Methods for Engineers", Tata Mc-Graw Hill, New Delhi,
   (2007).
5. Gerald C.F., and Wheatley P.O., "Applied Numerical Analysis", Pearson Education Asia, New Delhi,
   (2006).

191BM41	MEDICAL PHYSICS	L	T	P	C
		3	0	0	3

Programme: B.E. Biomedical Engineering **Sem:** 4 **Category:** PC

Aim: To effects of radiation in matter and how isotopes are produced.

Course Outcomes: The Students will be able to

CO1: Identify various detectors for detecting the presence of ionizing radiation.

CO2: formulate the principles and effects of ionizing and non-ionizing radiation in human body.

CO3: Know the fundamentals of radioactivity and radioactive isotopes

CO4: propose the methods of detecting and recording the ionizing radiation and its interaction with matter.

CO5: compare the intensities of sensory stimuli

CO6: Determine the production of radio nuclides

NON-IONIZING RADIATION AND ITS MEDICAL APPLICATIONS 9

Introduction and objectives - Tissue as a leaky dielectric - Relaxation processes, Debye model, Cole–Cole model, Overview of non-ionizing radiation Effects-Low Frequency Effects- Higher frequency effects. Physics of light, Measurement of light and its unit- limits of vision and color vision an overview, Ultraviolet

PHYSICS OF THE SENSES 7

Introduction and objectives - Cutaneous sensation - The chemical senses – Audition –Vision - Psychophysics

PRINCIPLES OF RADIOACTIVE NUCLIDES 10

Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity, Radionuclide used in Medicine and Technology ,Decay series, Production of radionuclides – Cyclotron produced Radionuclide- Reactor produced Radio- nuclide-fission and electron Capture reaction, Target and Its Processing Equation for Production of Radionuclides, radionuclide Generator-Technetium generator.

RADIOACTIVE DECAY AND INTERACTIONOF RADIATION WITH MATTER 11

Spontaneous Fission- Isomeric Transition-Alpha Decay-Beta Decay-PositronDecay-Electron Capture-Interaction of charged particles with matter –Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation,Interaction of X and Gamma radiation with matter- Photoelectric effect, Compton Scattering , Pair production, Attenuation of Gamma Radiation ,Interaction of neutron with matter and their clinical significance.

SCINTILLATION, SEMICONDUCTOR and GAS FILLED DETECTORS 8

Scintillation Detectors - Solid Scintillation Counters - Gamma-Ray Spectrometry-Liquid Scintillation Counters-Characteristics of Counting Systems-Gamma Well Counters-Thyroid Probe-Principles of Gas-Filled Detectors - Ionization Chambers-Geiger–Müller Counters

Total Periods: 45

Text Books:

1. Gopal B. Saha, ―Physics and Radiobiology of Nuclear Medicine‖, 4th Edition, Springer, 2013.
2. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, ―Medical Physics and Biomedical Engineering‖, 2nd Edition, IOP Publishers.2001.

References:

1. S.Webb ― The Physics of Medical Imaging‖, Taylor and Francis, 1988
2. J.P.Woodcock, ―Ultrasonic,Medical Physics Handbook series 1‖, Adam Hilger, Bristol, 2002
3. HyltonB.Meire and Pat Farrant ―Basic Ultrasound‖ John Wiley & Sons, 1995.

Course Outcomes	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	3	2	2	2	2	1	2	1	1	3	3	2	3	1
CO2	3	3	2	2	2	1			2	3		2	3	3	1	2
CO3	3	2	3	3	2	3	1	1		2		2	3	2	2	
CO4	3	2	1	1	3	2	2	1	2	2	1	1	3	2	3	2
CO5	3	3	2	2	2	3	2		1	1		1	3	2	2	1
CO6	3	3	2	1	3	3	1	2	1	2		1	3	3	2	

191EC42 **SIGNALS AND SYSTEMS** **L-T-P C**

3-0-0 3

Programme: B.E. - Electronics and Communication Engineering **Sem: 4 Category: PC**

Aim: To study and analyze the characteristics of continuous, discrete signals and systems.

Course Outcomes: The students will be able to

CO1: Analyze the principles and properties of signals and systems.

CO2: Apply the Fourier series and transforms of the sinusoidal signals

CO3: Utilize CT systems in the Frequency domain using Fourier Analysis

CO4: Apply Laplace transform to Continuous Time systems.

CO5: Apply Z transform to characterize Discrete time systems.

CO6: Apply Discrete Fourier Transform for the Discrete signals and also how to reduce the computation using FFT

CLASSIFICATION OF SIGNALS AND SYSTEMS **9**

Basic signals, Classification of signals – Continuous and Discrete signals, Periodic and Aperiadic signals, Deterministic and Random signals, Energy and Power signals – Classification of systems – Continuous and Discrete systems, Static and Dynamic, Linear and Nonlinear, Time-variant and Time-invariant, Causal and Non causal, Stable and Unstable, linear and circular convolution.

ANALYSIS OF CONTINUOUS TIME SIGNALS **9**

Fourier series analysis - Fourier and Laplace Transforms– Properties of Fourier and Laplace Transforms.

LINEAR TIME INVARIANT- CONTINUOUS TIME SYSTEMS **9**

Differential Equation-Block diagram representation-impulse response, convolution integrals-Laplace transform in Analysis of CT systems.

ANALYSIS OF DISCRETE TIME SIGNALS **9**

Baseband Sampling – Aliasing, Reconstruction of CT signal from DT signal- DTFT & its properties - Z Transform & its Properties.

LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS **9**

Difference Equations-Block diagram representation-Impulse response – Convolution sum-. Discrete Fourier Transform, Properties of DFT, FFT, Radix 2 DIF-FFT, Radix 2 DIT-FFT.

Total Periods: 45

Text Book:

1. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, Signals and Systems, PHI, 2nd Edition, 2008
2. Anand Kumar, Signals and Systems - PHI; 3rdedition, 2013

References:

1. Simon Haykin and Van Veen, Signals & Systems, Wiley, 3rd Edition, 2007.
2. Michel J. Robert, Fundamentals of Signals and Systems, MGH International Edition, 2008.
3. B.P. Lathi, Signals, Systems & Communications, BS Publications, 2008.
4. Narayan Iyer and K Satya Prasad,Signals & Systems, Cenage Pub, 2011

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	1							2	3		3	1
CO2	3	3	2	2	2							2	3		3	1
CO3	3	3	3	3	2							2	3		3	2
CO4	3	3	3	3	2							2	3		3	2
CO5	3	3	3	3	2							2	3		3	2
CO6	3	3	3	2	2							2	2	2	3	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EC43 **DIGITAL SYSTEMS** **L-T-P** **C**

3-0-0 **3**

Programme: B.E. - Electronics and Communication Engineering **Sem:** **4** **Category:** **PC**

Aim: The course aims at Circuit schematic development, Computer modelling, Simulation of digital system and verifies their functionality using the Hardware description Language (Verilog).

Course Outcomes: The students will be able to

CO1: Know what digital systems are, how they differ from analog systems and why it is advantageous to use digital systems in many applications

CO2: To apply the principles of Boolean algebra to manipulate and minimize logic expressions

CO3: Design and debug basic combinatorial and sequential logic circuits

CO4: Use state machine diagrams to design finite state machines using sequential circuits

CO5: Analyze MSI AND PLD components

CO6: Design, debug and verify simple digital circuits and systems with the aid of computer software including Verilog, schematic capture tools and simulation tools

NUMBER SYSTEM & MINIMIZATION TECHNIQUES **9**

Number system , Binary Arithmetic Operation , 1's and 2's complements,9's and 10's complement, Classification of binary Codes, Boolean logic operations and laws, De-Morgan's Theorem, Minimization of Boolean expressions , Sum of Products (SOP) , Product of Sums (POS), Karnaugh map Minimization (Three & Four variable), Quine-McCluskey method.

LOGIC GATES & COMBINATIONAL CIRCUITS **9**

Logic Gates, Mixed Logic, Half adder & Half Subtractor , Full Adder & Full Subtractor , Parallel binary adder, Parallel binary Subtractor, Fast Adder, Binary Multiplier, Binary Divider, Multiplexer / Demultiplexer, Decoder / Encoder , Parity checker, Parity generators , Code converters, Magnitude Comparator.

SEQUENTIAL CIRCUITS **9**

Flip-flops – SR, JK, D, T, and Master-Slave, Characteristic table and equation,Triggering of flip flops, Realization of one flip flop using other flip flops. Counters – Asynchronous & Synchronous Up/Down counter.Registers – Shift registers, Shift register counters. Design using Algorithmic State Machines and Finite State Machines, Design of Hazard Free Switching circuits.

9

MSI AND PLD COMPONENTS

Fixed-function devices-TTL, ECL, RTL, CMOS, RAM/ROM, Programmable devices-PROMs, PALs and PLDs, FPGAs

COMPUTER-AIDED DESIGN **9**

Hardware description languages (HDLs) - Introduction to Verilog, Logic compilation, Two-level and multi-level logic synthesis, Technology-independent optimization, Technology mapping, Sequential-logic synthesis.

TOTAL PERIODS 45

Text Book:

1. M.Morris Mano, Digital Design, 5th Edition, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2013.

References:

1. Donald D.Givone, Digital Principles and Design, TMH, 2007.
2. Donald P.Leach, Albert Paul Malvino, Goutam Shah "Digital principles & applications",7th edition, 2011
3. S. Salivahanan and S. Arivazhagan, Digital Circuits and Design, 3rd edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2007.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	2	1							2	2	3		2
CO2	2	3	2	2	2							2	2	3		2
CO3	3	3	3	3	2	1			3		1	2	2	3		2
CO4	3	3	3	3	2	1			3		1	2	2	3		2
CO5	3	3	3	2	2	1						2	2	3		2
CO6	2	3	3	2	1							2	2	3		2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191BM42	PATHOLOGY AND MICROBIOLOGY	L	T	P	C
		3	0	0	3

Programme: B.E. Biomedical Engineering **Sem: 4 Category: PC**

Aim: Gain a knowledge on the structural and functional aspects of living organisms.

Course Outcomes: The Students will be able to

CO1: List the importance of public health

CO2: Determine the methods involved in treating the pathological diseases

CO3: Analyse the structural and functional aspects of living organisms

CO4: Know the functions of microscope

CO5: List out he remedies in treating the pathological diseases

CO6: Formulate the morphological features and structural organization of bacteria and virus.

CELL DEGENERATION, REPAIR AND NEOPLASIA 9

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

FLUID AND HEMODYNAMIC DERANGEMENTS 9

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

MICROBIOLOGY 9

Structure of Bacteria and Virus. Routes of infection and spread; endogenous and exogenous infections, Morphological features and structural organization of bacteria and virus, growth curve, identification of bacteria , culture media and its types , culture techniques and observation of culture. Disease caused by bacteria, fungi, protozoal, virus and helminthes.

MICROSCOPES 9

Light microscope – bright field, dark field, phase contrast, fluorescence, Electron microscope (TEM & SEM). Preparation of samples for electron microscope. Staining methods – simple, gram staining and AFB staining.

IMMUNOPATHOLOGY 9

Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediated tissue injury: opsonization, phagocytosis, inflammation, Secondary immunodeficiency including HIV infection. Auto-immune disorders: Basic concepts and classification, SLE.Antibodies and its types, antigen and antibody reactions, immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, monoclonal antibodies.

Total Periods: 45

Text Books:

1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, ―Pathologic Basis of Diseases‖, 7th edition,WB Saunders Co. 2005 (Units I & II).
2. Ananthanarayanan & Panicker, ―Microbiology‖ Orientblackswan, 2017 10th edition. (Units III,IV and V).

References:

1. Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3rd edition, 2000.
2. Dubey RC and Maheswari DK. ―A Text Book of Microbiology‖ Chand & Company Ltd, 2007
3. Prescott, Harley and Klein, ―Microbiology‖, 10th edition, McGraw Hill, 2017.

Course Outcomes	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	1	2	3	2	2	1		1		3	3	3	3	1
CO2	3	3	2	2	3	2	1	1	2	2	1	2	3	3	2	2
CO3	3	2	2	3	2	3	1	2	1	3		2	3	3	2	1
CO4	3	2	2	3	3	2	2	3	1	2	1	2	3	2	2	2
CO5	3	3	2	2	3	3	3	1	1	2	1	2	3	2	1	1
CO6	3	3	3	1	3	3	1		2			2	3	1	2	2

191CS35	DATA STRUCTURES AND C++	L	T	P	C
		3	0	2	4

Programme:	B.E. Electronics and Communication Engineering	**Sem:III**	**Category:**	**ESC**
Prerequisites:	-			

AIM: To provide an in-depth knowledge in basic concepts of object oriented programming and fundamental concepts of data structures.

Course Outcomes:

The Students will be able to

CO1: Discuss the concepts of Object oriented programming.
CO2: Apply proper class protection mechanism to provide security.
CO3: Apply various object oriented features like inheritance, data abstraction, encapsulation and polymorphism to solve various computing problems using C++ language.
CO4: Discuss the importance of structure and abstract data type, and their basic usability.
CO5: Apply various data structure such as stacks, queues, linked lists, trees and graphs to Solve various computing problems.
CO6: Analyze the efficiency of algorithm and design their own data structure according to the application.

PRINCIPLES OF OBJECT ORIENTED PROGRAMMING 9

Introduction – Beginning with C++, Tokens, Expressions, Control Structures, Functions in C++, Classes and objects, Operators overloading and type conversions.

BASIC CONCEPTS OF OBJECT ORIENTED PROGRAMMING 9

Inheritance, Constructors and destructors, Pointers, Virtual functions and polymorphism, Exception handling.

LINEAR DATA STRUCTURES 9

Arrays and its representations – Stacks and Queues – Linked lists – Linked list-based implementation of Stacks and Queues – Evaluation of Expressions.

NON LINEAR DATA STRUCTURES 9

Trees – Binary trees – Binary tree representation and traversals –Binary Search Trees, Graph Algorithms – Representation – Shortest path algorithms: Dijkstra's algorithm – Minimum spanning tree.

SORTING 9

Sorting – Preliminaries – Bubble Sort, Insertion sort, Shell sort, Merge sort, Quick sort, Bucket sort.

LAB COMPONENT

LIST OF EXPERIMENTS:

1. Basic Programs for OOPS concepts.
2. Array implementation of stacks and queues.
3. Linked list implementation of stacks and queues.
4. Application of Stacks and Queues.
5. Implementation of Binary SearchTree.
6. Implementation of Sorting.

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 3rd edition, Pearson EducationAsia, 2014.
2. E. Balagurusamy, "Object Oriented Programming with C++", 4th edition, McGraw Hill CompanyLtd., 2009

REFERENCES:

1. Michael T. Goodrich, "Data Structures and Algorithm Analysis in C++", Wiley student edition, 2007.
2. Seymour, "Data Structures", The McGraw-Hill, 2007.
3. Jean – Paul Tremblay & Paul G.Sorenson, An Introduction to data structures with applications, Tata McGraw Hill edition, 2nd Edition, 2007.
4. John R.Hubbard, Schaum's outline of theory and problem of data structure with C++, McGraw-Hill, New Delhi, 2004.

191BM47 PATHOLOGY AND MICROBIOLOGY LABORATORY L T P C
0 0 4 2

OBJECTIVES: The student should be made to:

- Use Compound microscope
- Practice on chemical examinations, Cryoprocessing, Histopathological examinations etc

LIST OF EXPERIMENTS:

1. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)
2. Study of parts of compound microscope
3. Histopathological slides of benign and malignant tumours.
4. Manual paraffin tissue processing and section cutting (demonstration)
5. Cryo processing of tissue and cryosectioning (demonstration)
6. Basic staining – Hematoxylin and eosin staining.
7. Special stains – cresyl fast Blue (CFV)- Trichrome – oil red O – PAS
8. Capsule stain
9. Simple stain.
10. Gram stain.
11. AFB stain.
12. Antigen-Antibody reaction Immuno electrophoresis
13. Slides of malarial parasites, micro filaria and leishmania donovani.
14. Haematology slides of anemia and leukemia.
15. Study of bone marrow charts.

TOTAL: 60 PERIODS

OUTCOME:

- Student can perform practical experiments on tissue processing, cryoprocessing, staining Processes etc.

TEXT BOOK :

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

191EC51 ANALOG AND DIGITAL COMMUNICATION L T P C
3 0 0 3

Programme: B.E. Electronics and Communication Engineering **Sem: 5 Category: PC**

AIM: To analyze the various analog and digital modulation and demodulation techniques, transmitters & receivers used in communication systems.

Course Outcomes

CO1: Examine the principles of communication system and analog modulation techniques
CO2: Design the angle modulation circuits in communication systems
CO3: Evaluate the practical limitations in Communication Techniques such as aliasing and inter symbol interference (ISI)
CO4: Compare the performance of different digital modulation techniques.
CO5: Analyze the Performance of spread spectrum communication system
CO6: Utilize the multiple access techniques

AMPLITUDE MODULATION **9**

Need for modulation, Amplitude modulation, Virtues and limitations of Amplitude modulation, Linear modulation schemes, DSB-SC Modulation, Coherent detection, Costas receiver, Quadrature carrier multiplexing, SSB Modulation, vestigial side band modulation, Television signals, Frequency translation, Comparison of amplitude modulation systems.

ANGLE MODULATION **9**

Frequency and phase modulation. spectrum of FM Wave, modulation index and Bandwidth of FM Signal, NBFM and WBFM, Comparison between FM and PM Signals, FM and AM signals, AM and NBFM Signals, Generation of FM signals, Demodulation of FM signals, slope detector, ratio detector, Foster Seeley discriminator, Pre-emphasis & De-emphasis, – Capture effect, threshold effect.

DIGITAL TRANSMISSION AND DATA COMMUNICATION **9**

Introduction, pulse modulation, PCM – PCM sampling, sampling rate, signal to quantization noise rate, companding – analog and digital – percentage error, delta modulation, adaptive delta

modulation, differential pulse code modulation, pulse transmission – ISI, eyepattern, source and error control coding, Entropy, Source encoding theorem, Shannon Fano coding, Huffman coding, mutual information, channel capacity, channel coding theorem,Error control coding, linear block codes, cyclic codes, convolution codes, viterbi decoding algorithm.

DIGITAL COMMUNICATION **9**

Introduction, Shannon limit for information capacity, digital amplitude modulation, frequency shift keying, FSK bit rate and baud, FSK transmitter, BW consideration of FSK, FSK receiver, phase shift keying – binary phase shift keying – QPSK, Quadrature Amplitude modulation, bandwidth efficiency, carrier recovery – squaring loop, Costas loop, DPSK.

SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES **9**

Introduction, Pseudo-noise sequence, DS spread spectrum with coherent binary PSK, processing gain, FH spread spectrum, multiple access techniques – wireless communication, TDMA and FDMA, wireless communication systems, source coding of speech for wireless communications.

TOTAL PERIODS: 45

TEXT BOOKS

1. Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009.

REFERENCES

1.Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2004
2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007
3. H.Taub, D L Schilling and G Saha, "Principles of Communication", 3rd Edition, Pearson Education, 2007.
4. B. P.Lathi, "Modern Analog and Digital Communication Systems", 3rd Edition, Oxford University Press, 2007.
5. Blake, "Electronic Communication Systems", Thomson Delmar Publications, 2002.
6. Martin S.Roden, "Analog and Digital Communication System", 3rd Edition, Prentice Hall of India, 2002.
7. B.Sklar, "Digital Communication Fundamentals and Applications" 2nd Edition Pearson Education 2007.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	3							2	3	3	2	2
CO2	3	2	2	2								2	3	2	2	2
CO3	3	2	2	2	3	2	2					2	3	3	2	2
CO4	3	2	2	2								2	3	2	2	2
CO5	3	3	2	2	2	3	2					2	3	2	2	2
CO6	3	2	2	2	3	2						3	3	3	2	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191BM52 **BIOMEDICAL INSTRUMENTATION** **L T P C**
3 0 0 3

Programme: B.E. Biomedical Engineering **Sem: 5 Category: PC**
Aim: To study the different measurement techniques for non-physiological parameters
Course Outcomes: The Students will be able to
CO1: Identify the recording of bio signals(ECG, EEG, EOG, EMG)
CO2: Measure the non - electrical parameters
CO3: List the biochemical measurement techniques
CO4: Design of bio amplifier for various physiological recordings
CO5: Identify the different electrode placement for various physiological recordings.
CO6: Organize the various technique for non-electrical physiological measurements

BIOPOTENTIAL ELECTRODES **9**

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, Contact impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - motion artifacts, measurement with two electrodes.

BIOPOTENTIAL MEASUREMENTS **9**

Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven ‘s triangle, standard 12 lead system, Principles of vector cardiography.EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. Recording of ERG, EOG and EGG**.**

SIGNAL CONDITIONING CIRCUITS **9**

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier., Power line interference, Right leg driven ECG amplifier, Band pass filtering.

MEASUREMENT OF NON-ELECTRICAL PARAMETERS **9**

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

BIOCHEMICAL MEASUREMENT AND BIOSENSORS **9**

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors, Blood gas analyzers - colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description) – Bio Sensors – Principles – amperometric and voltometric techniques.

Total Periods: **45**

Text Books:

1. Leslie Cromwell, ―Biomedical Instrumentation and measurement‖, 2nd edition, Prentice hall of India, New Delhi, 2015.

References:

1. John G. Webster, ―Medical Instrumentation Application and Design‖, 4th edition, Wiley India Pvt Ltd,New Delhi, 2015.
2. Joseph J. Carr and John M. Brown, ―Introduction to Biomedical Equipment Technology‖, Pearson Education, 2004.
3. Myer Kutz, ―Standard Handbook of Biomedical Engineering and Design‖, McGraw Hill Publisher, 2003.
4. Khandpur R.S, ―Handbook of Biomedical Instrumentation‖, 3rd edition, Tata McGraw-Hill New Delhi, 2014.

Course Outcomes	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	2	3	2		1	2		3	3	2	3	1
CO2	3	3	3	2	2	3	1	2	2	1	1	1	3	2	2	
CO3	3	2	3	3	2	3	1	1	1	1		2	3	3	2	
CO4	3	2	3	3	3	2	2	2	3	1	1	2	3	2	2	
CO5	3	3	2	2	2	1	3	3	1		1	2	3	2	1	1
CO6	3	3	3	1	2	1	1	1	2			2	3	1	2	2

191BM53	SENSORS AND MEASUREMENTS	L	T	P	C
		2	0	2	3

Programme: B.E. Biomedical Engineering **Sem:** 5 **Category:** PC

Aim: To study the principle of transduction, classifications and the characteristics of different transducers

Course Outcomes: The Students will be able to

CO1: Measure the various electrical parameters with accuracy, precision, resolution.

CO2: Make Use of AC and DC bridges for relevant parameter measurement

CO3: Measure the passive or active transducers for physical phenomenon.

CO4: Identify the light sensor in physical phenomenon.

CO5: Know the concept of different types of recorder.

CO6: List out the functions of signal conditioning circuits.

SCIENCE OF MEASUREMENT **6+6**

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

DISPLACEMENT, PRESSURE, TEMPERATURE SENSORS **6+6**

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

PHOTOELECTRIC AND PIEZO ELECTRIC SENSORS **6+6**

Phototube, scintillation counter, photo multiplier tube (PMT), photovoltaic, photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers. Optical displacement sensors and optical encoders. Piezoelectric active transducer- Equivalent circuit and its characteristics.

SIGNAL CONDITIONING CIRCUITS **6+6**

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

DISPLAY AND RECORDING DEVICES **6+6**

Digital voltmeter – Multi meter – CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder.

Total Periods: **60**

Text Books:

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

References:

1. Ernest O Doebelin and Dhanesh N Manik, Measurement systems, Application and design, 6th edition, McGraw-Hill, 2012.
2. Khandpur R.S, ―Handbook of Biomedical Instrumentation‖, 3rd edition, Tata McGraw-Hill, New Delhi, 2014.
3. Leslie Cromwell, ―Biomedical Instrumentation and measurement‖, 2nd edition, Prentice hall of India, New Delhi, 2015.
4. Albert D.Helfrick and William D. Cooper. Modern Electronic Instrumentation and Measurement Techniques‖, Prentice Hall of India, 1stedition, 2016.

Course Outcomes	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	3	2	2	3	2		1	2		3	3	2	3	2
CO2	3	3	3	3	3	2	1	2	2	1	1	1	3	3	2	
CO3	3	2	3	2	2	3	1	1	1	1		2	3	3	2	1
CO4	3	2	2	3	3	3	2	2	3	1	1	2	3	2	2	
CO5	3	2	2	2	2	1	3	2	1		1	2	3	2	1	1
CO6	3	3	3	1	2	1	1	1	2			3	3	1	2	2

191EC54	DIGITAL SIGNAL PROCESSING AND ARCHITECTURE	L	T	P	C
		3	2	0	4

Programme: B.E. Electronics and Communication Engineering **Sem: 5** **Category: PC**

AIM: To design and implement IIR and FIR filters in digital signal processors

Course Outcomes

CO1: Design digital IIR Butterworth and Chebyshev filters.

CO2: Construct digital FIR filters using windowing technique.

CO3: Characterize the effects of finite precision representation on digital filters

CO4: Analyzethe power spectrum using parametric and non-parametric methods.

CO5: Apply adaptive filters appropriately in communication systems

CO6: Illustrate the architecture and programming of TMS processors

INFINITE IMPULSE RESPONSE FILTERS **9**

Characteristics of practical frequency selective filters. characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

FINITE IMPULSE RESPONSE FILTERS **9**

Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations

FINITE WORD LENGTH EFFECTS **9**

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

POWER SPECTRUM ESTIMATION **9**

Estimation of spectra from Finite duration observation of signals, non- parametric methods for power spectrum estimation -Welch, Bartlett methods, parametric methods for power spectrum estimation -Yule-Walker method for the AR model parameters

INTRODUCTION TO DIGITAL SIGNAL PROCESSORS

DSP functionalities - circular buffering – DSP architecture – Fixed and Floating point architecture principles, Introduction to ADSP- 2100 family of processors – Programming – Architecture of DSP chip TMS320C54x and TMS320C55x, TMS320C6X DSP chip CPU Operation

TOTAL PERIODS 45

TEXT BOOKS

1. John G. Proakis& Dimitris G.Manolakis, Digital Signal Processing – Principles, Algorithms & Applications‖, Fourth Edition, Pearson Education / Prentice Hall, 2007.

REFERENCES

1. Emmanuel C.Ifeachor& Barrie. W. Jervis, Digital Signal Processing, Second Edition, Pearson Education / Prentice Hall, 2002.
2. A. V. Oppenheim, R.W. Schafer and J.R. Buck, Discrete-Time Signal Processing, 8thIndian Reprint, Pearson, 2004.
3. Sanjit K. Mitra, Digital Signal Processing – A Computer Based Approach, Tata Mc Graw Hill, 2007.
4. Andreas Antoniou, Digital Signal Processing, Tata Mc Graw Hill, 2006.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3							2	2		3	
CO2	3	3	3	3	3							2	2	2	3	2
CO3	3	3	3	3	3							2	2	2	3	2
CO4	3	3	2	2	2							2	2		3	
CO5	3	3	2	3	3							2	2	2	2	2
CO6	3	3	2	3	3							2	2	2	2	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EC55 **EMBEDDED SYSTEMS AND IOT** **L T P C**
3 0 2 4

Programme: B.E. Electronics and Communication Engineering **Sem: 5** **Category: PC**

AIM: To design and develop embedded computer systems to adopt IoT.

Course Outcomes

CO1: Analyze the differences between the general computing system and the embedded system, also recognize the classification of embedded systems.

CO2: Develop various device drivers for embedded products.

CO3: Apply knowledge on the architecture and software aspects of ARM processor

CO4: Construct real time embedded systems using the concepts of RTOS.

CO5: Identify the internal design process of real time embedded products.

CO6: Elaborate the real-life case studies of embedded systems.

INTRODUCTION TO EMBEDDED SYSTEMS 9

Definition and Classification – Characteristics of embedded systems –Challenges of embedded systems – Overview of processors and hardware units in an embedded system – Software embedded into the system – Exemplary embedded Systems –Embedded system design process.

DEVICES DRIVERS ,BUSES AND INTERRUPT SERVICING MECHANISM 9

Overview of Embedded programming in ALP and C – Device drivers – Parallel port device drivers in a system- Serial port device drivers in a system- Device drivers for internal programmable timing devices – Embedded Buses – 12C- USB and CANBuses- Interrupt servicing mechanism – Context and period for context switching- Deadline and Interrupt latency

REAL TIME OPERATING SYSTEMS 9

Definitions of process, tasks and threads –Operating system services- Goals and structures - Kernel services – Concept of semaphores - RTOS task scheduling models – Co-operative Round Robin scheduling – Cyclic scheduling with time slicing– Preemptive scheduling model – Critical section service by a preemptive scheduler – Fixed (static) real time scheduling of tasks – Priority inversion problem and deadlock situations.

INTERNET OF THINGS 9

Definition – phases – Foundations – Policy– Challenges and Issues - identification - security –privacy. Components in internet of things: Control Units – Sensors – Communication modules – Power Sources – Communication Technologies – RFID – Bluetooth – Zigbee – Wifi – Rflinks – Mobile Internet – Wired Communication

PROGRAMMING THE MICROCONTROLLER FOR IOT 9

Basics of Sensors and actuators – examples and working principles of sensors and actuators – Cloud computing and IOT – Arduino/ Equivalent Microcontroller platform – Setting up the board - Programming for IOT – Reading from Sensors Communication: Connecting microcontroller with mobile devices – communication through Bluetooth and USB – connection with the internet using wifi / Ethernet

LIST OF EXPERIMENTS:

1. Simple Assembly language programming using 8051.
2. Configuring and interfacing 8051 I/O ports using KEIL IDE.
3. Interfacing, Programming of Stepper Motor /Servo Motor& DC Motor Speed control.
4. Making different LED pattern design using Arduino Board.
5. Buzzer/LCD interface using Arduino Board
6. Basic RTOS Application Design.
7. Mobile server Hacking using IoT
8. Client Server Model using IoT
9. Basic Robotic Kit using TIVA processor and IoT
10. Voice Activate Robot using IoT

TOTAL PERIODS 60

TEXT BOOKS

1. Rajkamal, "Embedded Systems Architecture, Programming and Design", Tata McGraw-Hill, 2nd Edition , 2009.
2.Dieter Uckelmann et.al, "Architecting the Internet of Things", Springer, 2011.

REFERENCES

1. Steve Heath, "Embedded Systems Design", 2nd Edition, Elsevier Publications, 2002.
2. David E-Simon, "An Embedded Software Primer", Pearson Education, 2007.
3. Frank Vahid and Tony Gwasrgie, "Embedded system Design", John Wiley and Sons, 2002.
4. Wayne Wolf, "Computers as Components – Principles of Embedded Computer System Design", 3rd Edition Morgan Kaufmann Publisher, 2006.
5.Cuno Pfister, "Getting Started with the Internet of Things", O'Reilly, 2011.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	2	2			2			2	2	2		3
CO2	3	2	3	2	2	2			2			2	2	2		3
CO3	2	3	3	3	3	2			2			2	2	2		3
CO4	3	3	3	2	3	3			2		2	2	2	2		3

CO5	2	3	2	2	2	2			2			2	2	2		3
CO6	2	3	2	2	2	2			2			2	2	2	3	3

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191BM57 BIO MEDICAL INSTRUMENTATION LABORATORY L T P C
0 0 4 2

OBJECTIVES:

To provide hands-on training on designing of bio signal acquisition system and measurement of physiological parameters, biochemical parameters.

LIST OF EXPERIMENTS:

1. Design of pre amplifiers to acquire bio signals along with impedance matching circuit using suitable IC‘s
2. Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts.
3. Design of EMG amplifier
4. Design a suitable circuit to detect QRS complex and measure heart rate
5. Design of frontal EEG amplifier
6. Design of EOG amplifier to detect eye blink
7. Design a right leg driven ECG amplifier.
8. Design and study the characteristics of optical Isolation amplifier
9. Design a Multiplexer and Demultiplexer for any two biosignals.
10. Measurement of pulse-rate using Photo transducer.
11. Measurement of pH and conductivity.
12. Measurement of blood pressure using sphygmomanometer.
13. Measurement and recording of peripheral blood flow
14. Design a PCB layout for any bio amplifier using suitable software tool.

TOTAL: 60 PERIODS

OUTCOMES: At the end of the lab, the student should be able to:

- Design preamplifiers and amplifiers for various bio signal recordings.
- Measure various non-electrical parameters using suitable sensors/transducers
- Design PCB layout for any bio amplifier.

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS:

pH meter and conductivity meter: 1 No.
Photo transducer for pulse measurement: 1 No.
Sphygmomanometer and Stethoscope: 1 No.
Blood flow measurement system: 1 No.

Multiparameter (ECG, EMG, EEG) Simulator: 2 No.
Function generator, DSO,Regulated Power supplies,Bread boards – 8 each
IC LM 324,AD 620, INA series (126,128 etc.), 555 Timer: 20 each
Opto Isolator IC: MCT2E – 1 No.
Software tool for PCB design: 1

191EC58	**DSP AND PROCESSORS LABORATORY**	**L-T-P**	**C**
		0-0-4	**1**

Programme: B.E. Electronics and Communication Engineering **Sem:** 5 **Category:** **PC**

AIM: The purpose of this course is to develop skills of the students in implementing Digital signal Processing techniques using MATLAB and Processors.

Course Outcomes: The students will be able to

CO1: Construct algorithms of Digital Signal Processing techniques like convolution and Fourier Transform.

CO2: Experiment with Integrated Development Environment (Code Composer Studio)for Digital Signal
Processor.

CO3: Interpret the architecture of Digital Signal Processors.

CO4: Implement linear and circular convolution.

CO5: Analyze the different types of filters using DSP Processor and Matlab.

CO6: Design adaptive filters for various applications of DSP.

LIST OF EXPERIMENTS:

MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of sequences (functional & random)
2. Linear and Circular Convolutions
3. FIR filter design
4. IIR filter design
5. Multirate Filters
6. Determination of Power Spectrum of a given signal

DSP PROCESSOR BASED IMPLEMENTATION

1. Study the architecture of DSP chips – TMS 320C 5X/6X Instructions and its addressing modes
2. Generation of sine, square and triangular waveforms
3. Implementation of linear and circular convolution
4. Sampling of input signal and display
5. Implementation of FIR filter
6. Implementation of IIR filter
7. Implementation of Radix – 2 FFT using ADSP 21XX processor.
8. Adaptive filter for noise cancellation
9. Implementation of Multirate signal processing – Decimation and Interpolation filter

(Note: Experiments may be done using any one of the TMS320C5X/ TMS320C67XX/ ADSP21XX family of processors)

TOTAL PERIODS 45

Course Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	2				3	1	2	2	3	2	3	3
CO2	3	3	3	3	2				3	1	2	2	3	2	3	3
CO3	3	3	3	2	2				3	1	2	2	2	2	3	3
CO4	3	3	3	3	2				3	1	2	2	3	2	3	3
CO5	3	3	3	2	2				3	1	2	2	3	2	3	3
CO6	3	3	3	3	2	2			3	1	2	2	3	2	3	3

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191BM61	BIOCONTROL SYSTEMS	L	T	P	C
		4	0	0	4

Programme: B.E. Biomedical Engineering **Sem:** 6 **Category:** BSC

Aim: To apply mathematical modelling principles in understanding the various fundamental biological systems .

Course Outcomes: The Students will be able to

CO1: Know the concept behind feedback and continuum in various systems and subsystems.

CO2: Analyze the time response of various systems and discuss the concept of system stability

CO3: Analyze the frequency response characteristics of various systems using different charts.

CO4: Extend the concept of modeling basic physiological systems

CO5: List out the application aspects of time and frequency response analysis in physiological control systems

CO6: Explain the need for mathematical modeling of various systems,

INTRODUCTION **12**

Open and Closed loop Systems, Modeling and Block Diagrams, Block diagram and signal flow graph representation of systems, reduction of block diagram and signal flow graph, Introduction to Physiological

control systems- Illustration, Linear models of physiological systems, Difference between engineering and physiological control system.

TIME RESPONSE ANALYSIS **12**

Step and impulse responses of first order and second order systems, time domain specifications of first and second order systems, steady state error constants, Definition of stability, Routh- Hurwitz criteria of stability, root locus technique, construction of root locus and study of stability.

FREQUENCY RESPONSE ANALYSIS **12**

Frequency domain specifications - Polar plots, Bode plots, Nyquist plot, Nyquist stability criterion, closed loop stability, Constant M and N circles, Nichol's chart.

BIOLOGICAL SYSTEM MODELS **12**

Distributed parameter versus lumped parameter models, Model development of Cardiovascular system- Heart model-circulatory model, Pulmonary mechanics- Lung tissue visco-elastance-chest wall- airways, Interaction of Pulmonary and Cardiovascular models, Static analysis of physiological systems – Regulation of cardiac output, Regulation of ventilation.

BIOLOGICAL CONTROL SYSTEM ANALYSIS **12**

Simple models of muscle stretch reflex action, Study of steady state analysis of muscle stretch reflex action, Study of transient response analysis of neuromuscular reflex model action, Study of frequency response of circulatory control model, Stability analysis of Pupillary light reflex.

Total Periods: **60**

Text Books:

1.J. Nagarath and M. Gopal ―Control Systems Engineering", Fifth Edition, Anshan Publishers, 2008.(UNIT

2.Michael C K Khoo, ―Physiological Control Systems‖, IEEE Press, Prentice Hall of India, 2005

References:

1. Benjamin C. Kuo, ―Automatic Control Systems‖, Prentice Hall of India, 1995.
2. John Enderle Susan Blanchard, Joseph Bronzino ―Introduction to Biomedical Engineering‖, second edition, Academic Press, 2005.
3. Richard C. Dorf, Robert H. Bishop, ―Modern control systems‖, Pearson, 2004.

Course Outcomes	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	3	2	2	3	2		1	2		3	3	2	3	2
CO2	3	2	3	3	1	2	1	2	2	1	1	1	3	2	2	1
CO3	3	2	2	3	2	2	1	1	1	1	1	2	3	3	2	1
CO4	3	2	2	3	3	3	2	2	3	1	1	2	3	1	2	1
CO5	3	2	2	2	2	1	3	2	1		1	2	3	2	1	1
CO6	3	3	3	1	2	1	1	1	2	1		3	3	1	2	2

191EC62

L	T	P	C
3	0	0	3

Programme: B.E. Electronics and Communication Engineering **Sem: 6** **Category: PC**

AIM: To understand the need for machine learning for various problem solving and learn the new approaches in machine learning to design appropriate algorithms for problem solving

Course Outcomes

CO1: Distinguish between supervised, unsupervised, semi-supervised machine learning approaches

CO2: Apply specific supervised or unsupervised machine learning algorithm for a particular problem

CO3: Analyse and suggest the appropriate machine learning approach for the various types of problem

CO4: Design and make modifications to existing machine learning algorithms to suit an individual application

CO5: Provide useful case studies on the advanced machine learning algorithms

CO6: Design design appropriate machine learning algorithms for problem solving

INTRODUCTION 9

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

NEURAL NETWORKS AND GENETIC ALGORITHMS 9

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – SupportVector Machine

BAYESIAN AND COMPUTATIONAL LEARNING 9

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

INSTANT BASED LEARNING 9

K- Nearest Neighbour Learning – Locally weighted Regression – Radial Bases Functions – Case Based Learning.

ADVANCED LEARNING 9

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

TOTAL PERIODS 45

TEXT BOOKS

1. Tom M. Mitchell, ―Machine Learning‖, McGraw-Hill Education (India) Private Limited, 2013.

REFERENCES

1. EthemAlpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning)‖, The MIT Press 2004.
2. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective‖, CRC Press, 2009

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2								1	2	2	3	2
CO2	2	2	2	2	2	1						1	2		3	2
CO3	2	2	2	2	2	1						1	2		3	2
CO4	3	2	2	2	2							1			3	2
CO5	3	2	2	2	2	1						1	2		3	2
CO6	2	2	2	2	1							1			3	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191BM62	HOSPITAL MANAGEMENT	L	T	P	C
		3	0	0	3

Programme: B.E. Biomedical Engineering **Sem:** 6 **Category:** PC

Aim: To study the various information management systems and relative supportive services.

Course Outcomes: The Students will be able to

CO1: Know the fundamentals of hospital administration and management

CO2: Develop to learn the quality and safety aspects in hospital.

CO3: formulate the principles of Hospital administration.

CO4: Identify the importance of Human resource management

CO5: Determine the safety procedures followed in hospitals

CO6: Identify the Information management systems and its uses.

OVERVIEW OF HOSPITAL ADMINISTRATION **9**

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning - Current Issues in Hospital Management – Telemedicine - Bio-Medical Waste Management

HUMAN RESOURCE MANAGEMENT IN HOSPITAL **9**

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment,

Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer, Communication – nature, scope, barriers, styles and modes of communication

MARKETING RESEARCH PROCESS 9

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations – Consumer Markets & Consumer Buyer Behaviour - Model of consumer behaviour - The buyer decision process - Model of business buyer behavior – Major types of buying situations - WTO and its implications

HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES 9

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department – Pharmacy– Food Services - Laundry Services.

QUALITY AND SAFETY ASPECTS IN HOSPITAL 9

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABA, JCI, NABL. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup.

Total Periods: 45

Text Books:

1.R.C.Goyal, ―Hospital Administration and Human Resource Management‖, PHI – Fourth Edition, 2006.

2.G.D.Kunders, ―Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

References:

1.Cesar A.Caceres and Albert Zara, ―The Practice of Clinical Engineering, Academic Press, New York, 1977.

2.Norman Metzger, ―Handbook of Health Care Human Resources Management‖, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.

3.Peter Berman ―Health Sector Reform in Developing Countries‖ - Harvard University Press, 1995.

4.William A. Reinke ―Health Planning For Effective Management‖ - Oxford University Press.1988

5.Blane, David, Brunner, ―Health and SOCIAL Organization: Towards a Health Policy for the 21st Century‖, Eric Calrendon Press 2002.

6.Arnold D. Kalcizony & Stephen M. Shortell, ―Health Care Management‖, 6th Edition Cengage Learning, 2011

Course Outcomes	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	2	3	2	2	3	2		2	2		3	3	2	3	1
CO2	3	2	3	2	2	3	2	1	2	1	1	1	3	3	2	
CO3	3	2	2	2	3	2	2	1	1	2		2	3	2	2	
CO4	3	2	3	3	2	2	2	2	2	1	1	2	3	2	2	

CO5	3	3	2	2	2	2	3	3	1	1	1	2	3	3	1	1
CO6	3	3	3	1	2	1	1	1	2			2	3	1	2	1

L	T	P	C
3	0	0	3

191BM63 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT-1

Programme: B.E. Biomedical Engineering **Sem: 6 Category: ESC**

Aim: Gain the knowledge of measure the biological signals in diagnostic and therapeutic equipment's.

Course Outcomes: The Students will be able to

CO1: Determine the devices for measurement of parameters are related to cardiology.

CO2: Recording the measurement of EEG and its uses.

CO3: Explain the working and recording of all basic neurological equipment's.

CO4: Recording the diagnostic and therapeutic equipment's related to EMG

CO5: Measure the parameters are related to respiratory system.

CO6: Know the concept of sensory measurement.

CARDIAC EQUIPMENT 9

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, ECG machine maintenance and troubleshooting, Cardiac Pacemaker- Internal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External, Defibrillator Protection Circuit, Cardiac ablation catheter.

NEUROLOGICAL EQUIPMENT 8

Clinical significance of EEG, Multi-channel EEG recording system, Epilepsy, Evoked Potential–Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph). EEG Bio Feedback Instrumentation. EEG system maintenance and troubleshooting.

MUSCULAR AND BIOMECHANICAL MEASUREMENTS 10

Recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation. Static Measurement – Load Cell, Pedobarograph. Dynamic Measurement – Velocity, Acceleration, GAIT, Limb position

RESPIRATORY MEASUREMENT SYSTEM 10

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

SENSORY MEASUREMENT 8

Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Speech, Eye Tonometer, Applanation Tonometer, slit lamp, auto refractometer.

Total Periods: 45

Text Books:

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

References:

1. Myer Kutz, ―Standard Handbook of Biomedical Engineering & Design‖, McGraw Hill, 2003.

2. L.A Geddes and L.E.Baker-Principles of Applied Biomedical Instrumentation‖, 3rd Edition, 2008
3. Leslie Cromwell, ―Biomedical Instrumentation and Measurement‖, Pearson Education, New Delhi, 2007.
4. Antony Y.K.Chan,‖Biomedical Device Technology,Charles Thomas Publisher Ltd, Illinois, USA, 2008.
5. B H Brown, R H Smallwood, D C Barber-Medical Physics and Biomedical Engineering‖, 2nd Edition, IOP Publishers. 2001.

Course Outcomes	**Programme Outcomes (POs)**												**Programme Specific Outcomes (PSOs)**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	3	2	2	3	2		2	2		3	3	2	3	1
CO2	3	2	2	3	2	3	2	1	2	1	1	1	3	3	2	1
CO3	3	1	2	2	1	2	2	1	1	2	1	2	3	2	2	2
CO4	3	2	3	3	2	2	1	2	2	1	1	2	3	2	2	1
CO5	3	3	1	2	2	2	3	3	1	1	1	2	3	3	1	1
CO6	3	3	3	1	2	1	1	1	2	2	1	2	3	1	2	1

191EC67	MACHINE LEARNING LABORATORY	L	T	P	C
		3	0	0	1

Programme: B.E. Electronics and Communication Engineering **Sem: 6** **Category: PC**

AIM: Enable students to make use of Data sets in implementing the machine learning algorithms

Course Outcomes

CO1: Understand the implementation procedures for the machine learning algorithms
CO2: Utilize data sets for implementing machine learning algorithms
CO3: Design Java/Python programs for various Learning algorithms.
CO4: Apply appropriate data sets to the Machine Learning algorithms
CO5: Identify and apply Machine Learning algorithms to solve real world problems
CO6: Implement the machine learning concepts and algorithms in any suitable language of choice.

LIST OF EXPERIMENTS

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs

TOTAL PERIODS 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2					3		1	1	2	2	3	2
CO2	2	2	2	2	2	1			3		1	1	2		3	2
CO3	2	2	2	2	2	1			3		1	1	2		3	2
CO4	3	2	2	2	2			1	3			1			3	2
CO5	3	2	2	2	2	1			3			1	2		3	2
CO6	2	2	2	2	1			1	3		1	1			3	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EC69 **MINI PROJECT** **L-T-P** **C**

0-0-2 **1**

Programme: B.E. Electronics and Communication Engineering **Sem 6 Category EEC**

AIM: To develop a simplified electronic circuits and communication systemmodel suitable for any application

The students will be able to

CO1. Identify suitable problem in electronic circuits and communication systems
CO2. Apply the knowledge of fundamental engineering
CO3. Design and Develop a suitable solution for the problem
CO4. Enhance the technical and non-technical Knowledge
CO5. Optimize the performance cost
CO6. Prepare documentation of observed results and maintain team work

Total Periods 30

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2	1	1	1	3	1	2	2	3	2	2	3
CO2	3	2	2	2	2	1			3	1	2	2	3	2	2	3
CO3	3	3	2	2	2		1	1	3	1	2	1	3	2	2	3
CO4	3			2	2	1			3	1	2	2	3	2	2	3
CO5	3	3	3	2	2	1	1		3	1	2	2	3	2	2	3
CO6	3				2				3	1	2	2	3	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EC71 ROBOTICS AND ARTIFICIAL INTELLIGENCE

L	T	P	C
3	0	0	3

Programme: B.E. Electronics and Communication Engineering **Sem: 7** **Category:BSC**

AIM:

Course Outcomes

CO1: Identify problems that are amenable to solution by AI methods.
CO2: Identify appropriate AI methods to solve a given problem.
CO3: Formalise a given problem in the language/framework of different AI methods.
CO4: Implement basic AI algorithms.
CO5: Design and carry out an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.
CO6: List out the various methods in learning.

INTRODUCTION

Types of Robot–Technology-Robot classifications and specifications-Design and control issues-Various manipulators – Sensors - Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. PROBLEM SOLVING: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems–Adversarial search, knowledge and reasoning–knowledge representation – first order logic.

PLANNING

Planning withforward and backward State space search – Partial order planning – Planning graphs–Planning with propositional logic – Planning and acting in real world.

REASONING

Uncertainity – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters–Dynamic Bayesian Networks, Speech recognition, making decisions.

LEARNING

Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception.

AI IN ROBOTICS

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

TOTAL PERIODS 60

TEXT BOOKS

1. Stuart Russell, Peter Norvig, “Artificial Intelligence: A modern approch”, Pearson Education, India2003.
2. Negnevitsky, M, “Artificial Intelligence: A guide to Intelligent Systems”,. Harlow: Addison-Wesley, 2002.

REFERENCES

1. David Jefferis, “Artificial Intelligence: Robotics and Machine Evolution”, Crabtree Publishing Company, 1992.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	2	2						2	2	2		3
CO2	3	2	3	2	2	2						2	2	2		3
CO3	2	3	3	3	3	2						2	2	2		3
CO4	3	3	3	2	3	3			2		2	2	2	2		3
CO5	2	3	2	2	2	2						2	2	2		3
CO6	2	3	2	2	2	2						2	2	2	3	3

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191BM71	RADIOLOGICAL EQUIPMENTS	L	T	P	C
		3	0	0	3

Programme: B.E. Biomedical Engineering **Sem:** 7 **Category:** PC
Aim: To study the principles and its types of radiological equipment's

Course Outcomes: The Students will be able to
CO1: Organize the generation of X-ray and its uses in imaging
CO2: Identify the generations of CT and its applications.
CO3: Explain the principles of different radio diagnostic equipment in Imaging
CO4: Examine the working principle of X ray machine and its application
CO5: List out the applications of radio nuclide imaging
CO6: Know the fundamentals and the concept of MRI

MEDICAL X-RAY EQUIPMENT **9**

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Cathode and filament currents, Focusing cup, Thermionic emission, Electromagnetic induction, Line focus principle and the heel effect, Causes of x-ray tube failure: Electron arcing/filament burn out, Failure to warm up tube, High temp due to over exposure, x-ray tube rating charts'-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, Cine Angiography, Digital subtraction Angiography. Mammography and Dental x-ray unit.

COMPUTED TOMOGRAPHY **9**

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors-Viewing systems- spiral CT scanning – Ultra fast CT scanners. Advantages of computed radiography over film screen radiography: Time, Image quality, Lower patient dose, Differences between conventional imaging equipment and digital imaging equipment: Image plate, Plate readers, Image characteristics, Image reconstruction techniques- back projection and iterative method. Spiral CT, 3D Imaging and its application

MAGNETIC RESONANCE IMAGING **9**

Fundamentals of magnetic resonance- Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system- system magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), and shim coils, Electronic components, fMRI.

NUCLEAR MEDICINE TECHNIQUES **9**

Nuclear imaging – Anger scintillation camera –Nuclear tomography – single photon emission computer tomography, positron emission tomography – Recent advances .Radionuclide imaging- Bone imaging, dynamic renal function, myocardial perfusion. Non imaging techniques- hematological measurements, Glomerular filtration rate, volume measurements, clearance measurement, whole -body counting, surface counting.

RADIATION THERAPY AND RADIATION SAFETY **9**

Radiation therapy – linear accelerator, Telegamma Machine. SRS –SRT,-Recent Techniques in radiation therapy - 3DCRT – IMRT – IGRT and Cyber knife- radiation measuring instruments- Dosimeter, film badges, Thermo Luminescent dosimeters- electronic dosimeter- Radiation protection in medicine- radiation protection principles.

Total Periods: **45**

Text Books:

1. Steve Webb, ―The Physics of Medical Imaging‖, Adam Hilger, Philadelpia, 1988 (Units I, II, III & IV).
2. R.Hendee and Russell Ritenour ―Medical Imaging Physics‖, Fourth Edition William, Wiley-Liss, 2002.

References:

1. Gopal B. Saha ―Physics and Radiobiology of Nuclear Medicine‖- Third edition Springer, 2006.

2. B.H.Brown, PV Lawford, R H Small wood, D R Hose, D C Barber, ―Medical physics and Biomedical Engineering‖, - CRC Press, 1999.
3. Myer Kutz, ―Standard handbook of Biomedical Engineering and design‖, McGraw Hill, 2003.
4. P.Ragunathan, ―Magnetic Resonance Imaging and Spectroscopy in Medicine Concepts and Techniques‖,Paperback – Import, 2007

Course Outcomes	**Programme Outcomes (POs)**												**Programme Specific Outcomes (PSOs)**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	2	2	3	2		1	2		3	3	2	3	1
CO2	3	2	2	3	2	2	1	2	2	1	1	1	3	3	2	
CO3	3	2	3	3	2	3	1	1	1	1		2	3	2	2	1
CO4	3	2	3	2	2	2	2	2	3	1	1	2	3	1	2	
CO5	3	2	2	2	1	1	3	3	1		1	2	3	2	1	1
CO6	3	3	3	1	2	1	1	1	2			2	3	1	2	2

191EC72	DIGITAL IMAGE PROCESSING	L-T-P	C
		3-0-0	3

Programme: B.E. Electronics and Communication Engineering **Sem:** 7 **Category:** PC

AIM: To learn digital image fundamentals and familiar with image compression and segmentation techniques

Course Outcomes: The Students will be able to

CO1: Summarize the basic concepts of sampling, quantization , relationships between pixels and color models.
CO2: Compare and contrast the image enhancement using spatial domain and frequency domain
CO3: Identify the image restoration model and different noise models.
CO4: Explain the methods of image segmentation.
CO5:Analyze compression techniques and the standards.
CO6: Represent features of images.

DIGITAL IMAGE FUNDAMENTALS **9**

Introduction – Origin – Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals -RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

IMAGE ENHANCEMENT **9**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering – **Frequency Domain:** Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters.

IMAGE RESTORATION AND SEGMENTATION **9**

Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filteringSegmentation:Detection of Discontinuities–Edge Linking and Boundary detection – Region based segmentation-Morphological processing- erosion and dilation - Segmentation by morphological watersheds.

WAVELETS AND IMAGE COMPRESSION **9**

Wavelets – Subband coding - Multiresolution expansions - Compression: Fundamentals – Image Compression models – Error Free Compression – Variable Length Coding – Bit-Plane Coding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding – CompressionStandards.

IMAGE REPRESENTATION AND RECOGNITION **9**

Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier Descriptor, moments- Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL PERIODS 45

TEXT BOOKS

1.Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.
2.Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.

REFERENCES

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
2. Willliam K Pratt, "Digital Image Processing", John Willey, 2002.
3. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI LearningPvt. Ltd., 2011.
4. http://eeweb.poly.edu/~onur/lectures/lectures.html.
5. http://www.caen.uiowa.edu/~dip/LECTURE/lecture.html

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2								1	2	2	3	2
CO2	2	2	2	2	2	1						1	2		3	2
CO3	2	2	2	2	2	1						1	2		3	2
CO4	3	2	2	2	2							1			3	2
CO5	3	2	2	2	2	1						1	2		3	2
CO6	2	2	2	2	1							1			3	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

		L	T	P	C
191BM72	**DIAGNOSTIC AND THERAPEUTIC EQUIPMENT- II**	**3**	**0**	**0**	**3**

Programme: B.E. Biomedical Engineering **Sem:** 7 **Category:** ESC
Aim: To study the principles of diagnostic and therapeutic equipment's.

Course Outcomes:
The Students will be able to
CO1: List out the types of diathermy and its applications
CO2: Importance and function of basic procedure in ultrasound and its applications in medicine
CO3: Know the concept of various extracorporeal and special diagnostic devices used in hospitals
CO4: Make use of various equipment's in ICU and its applications of telemetry.
CO5: Know the concept of dialyzer.
CO6: Identify the importance of patient safety against electrical hazard.

PATIENT MONITORING AND BIOTELEMETRY **9**

Patient monitoring systems, ICU/CCU Equipment's, bed side monitors, Infusion pumps, Central consoling controls. Radio Telemetry (single, multi), Portable and Landline Telemetry unit, Applications in ECG and EEG Transmission.

DIATHERMY **9**

IR and UV lamp and its application. Short wave diathermy, ultrasonic diathermy, Microwave diathermy, Electro surgery machine - Current waveforms, Tissue Responses, Electro surgical current level, Hazards and safety procedures.

ULTRASONIC EQUIPMENTS **9**

Diagnosis: Tissue Reaction, Basic principles of Echo technique, display techniques A, B and M mode, B Scan, Application of ultrasound as diagnostic tool – Echocardiogram, Echoencephalogram, abdomen, obstetrics and gynecology, ophthalmology.

EXTRA CORPOREAL DEVICES AND SPECIAL DIAGNOSTIC TECHNIQUES **9**

Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenators, finger pump, roller pump, electronic monitoring of functional parameters. Hemo Dialyser unit, Lithotripsy, Principles of Cryogenic technique and application, Endoscopy, Laparoscopy, Otoscopes. Thermography – Recording and clinical application.

PATIENT SAFETY **9**

Physiological effects of electricity – important susceptibility parameters – Macro shock – Micro shock hazards – Patient's electrical environment – Isolated Power system – Conductive surfaces – Electrical safety codes and standards – IEC 60601-1 2005 standard, Basic Approaches to Protection against shock, Protection equipment design, Electrical safety analyser – Testing the Electric system

Total Periods: **45**

Text Books:

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

References:

1. Leslie Cromwell, ―Biomedical Instrumentation and measurement‖, 2nd edition, Prentice hall of India, New Delhi, 2015.
2. Richard Aston ―Principles of Biomedical Instrumentation and Measurement‖, Merril Publishing Company, 1990.
3. L.A Geddas and L.E.Baker ―Principles of Applied Biomedical Instrumentation‖ 2004.
4. Myer Kutz ―Standard Handbook of Biomedical Engineering & Design‖, McGraw-Hill Publisher, 2003.
5. Khandpur R.S, ―Handbook of Biomedical Instrumentation‖, 3rd edition,Tata McGraw-Hill, New Delhi, 2014.

Course Outcomes	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	2		1	2	1	3	3	2	3	1
CO2	3	2	2	2	3	3	1	2	2	1		1	3	2	2	2
CO3	3	3	3	3	2	3	2	1	1	1		3	3	3	2	1
CO4	3	2	3	3	3	2	2	2	3	1	1	2	3	2	2	2
CO5	3	2	2	2	2	1	2	2	1	2	1	2	3	3	1	1
CO6	3	3	3	1	2	1	1	1	2	1		2	3	1	1	2

191EC77	ROBOTICS AND ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C
		3	0	0	1

Programme: B.E. Electronics and Communication Engineering **Sem: 7** **Category: PC**

AIM:

Course Outcomes

CO1: Determine the position links
CO2: Verify the transformation with respect to gripper and co-ordinate system
CO3: Evaluate the performance of the robot.
CO4: Develop programming for color and shape identification
CO5: Develop programming and simulation for writing practice.
CO6: Design robots for multiprocess

LIST OF EXPERIMENTS

1. Determination of maximum and minimum position of links.
2. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
3. Estimation of accuracy, repeatability and resolution.
4. Robot programming and simulation for pick and place
5. Robot programming and simulation for Colour identification
6. Robot programming and simulation for Shape identification
7. Robot programming and simulation for machining (cutting, welding)
8. Robot programming and simulation for writing practice
9. Robot programming and simulation for any industrial process (Packaging, Assembly)
10. Robot programming and simulation for multi process.

TOTAL PERIODS 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3	3	2			3	1	2	2	2	2		3
CO2	3	2	2	2	2	2			3	2	2	2	2	2		3
CO3	3	2	2	3	2	2			3	1	2	2	2	2		3
CO4	3	3	2	2	3	2			3	1	2	3	2	2		3
CO5	2	2	3	2	3	2			3	2	2	2	2	2		3
CO6	2	2	3	2	3	2			3	1	2	2	2	2		3

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EC78 DIGITAL IMAGE PROCESSING LABORATORY L T P C
3 0 0 3

Programme: B.E. Electronics and Communication Engineering **Sem: 7** **Category:PC**

AIM:

Course Outcomes

CO1: Perform enhancing operations on the image using spatial filters and frequency domain filters.
CO2: Use transforms and analyse the characteristics of the image
CO3: Perform segmentation operations in the images
CO4: Estimate the efficiency of the compression technique on the images.
CO5: Apply image processing technique to solve real health care problems.
CO6: Elaborate the DICOM standards

LIST OF EXPERIMENTS

Simulation using MATLAB
1.Image sampling and quantization
2.Analysis of spatial and intensity resolution of images.
3.Intensity transformation of images.
4.DFT analysis of images
5.Transforms (Walsh, Hadamard, DCT, Haar)
6.Histogram Processing and Basic Thresholding functions
7.Image Enhancement-Spatial filtering
8.Image Enhancement-Filtering in frequency domain
9.Image segmentation–Edge detection, line detection and point detection.
10.Basic Morphological operations and Segmentation using watershed transformation
11.Region based Segmentation
12.Analysis of images with different color models.
13.Study of DICOM standards
14.Image compression and Image restoration techniques

TOTAL PERIODS 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2					3	1	1	1	2	2	3	2
CO2	2	2	2	2	2	1			3	1	1	1	2		3	2
CO3	2	2	2	2	2	1			3	1	1	1	2		3	2
CO4	3	2	2	2	2				3	1	1	1			3	2
CO5	3	2	2	2	2	1			3	1	1	1	2		3	2
CO6	2	2	2	2	1				3	1	1	1			3	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

191EC79 **PROJECT WORK - I** **L T P C**

0 0 6 2

Programme: B.E Electronics and Communication Engineering **Sem: 7** **Category: EEC**

Aim: To develop a simplified electronics and communication model suitable for any application.

Course Outcomes: The Students will be able to

CO1: Make use of new tools and apply it.

CO2: Create new ideas for solving problems.

CO3: Schedule the works under different persons (Project Management skills).

CO4: Develop the skill to communicate effectively and demonstrate the work.

CO5: Develop and analyze solutions for critical real-world Problem.

CO6: Work as an individual and as a team.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	3	1		2	3	1	2	2	3	3	3	3
CO2	3	3	3	3	2	2	2		3		2	2	3	3	3	3
CO3	3	2			2	2	1	2	3	3	3	2	2	2	2	2
CO4	3	2	2	1	1			2	3	3	3	2	2	2	2	2
CO5	3	3	2	2	2				3		3	2	3	3	3	3
CO6						1			3	2	3	1	3	2	2	3

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

	L	T	P	C
191OE901	3	0	0	3

TELE HEALTH TECHNOLOGY

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**
Aim: To study the principles of Telemedicine and its standards.

Course Outcomes: The Students will be able to
CO1: Apply multimedia technologies in telemedicine
CO2: Identify the encryption techniques for secure transmission of data
CO3: Know tele medical standards, mobile telemedicine and it applications
CO4: Apply telehealth in healthcare.
CO5: Know the concept of legal aspects of telemedicine
CO6: List out the applications of telemedicine

FUNDAMENTALS OF TELEMEDICINE **9**

History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, Telemedicine Systems, benefits & limitations of telemedicine.

TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE **9**

Audio, video, still images, text and data, fax-type of communications and network: PSTN, POTS, ANT, ISDN, internet, air/ wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare.

ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE **9**

Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment - data protection & security, jurisdictional issues, intellectual property rights.

PICTURE ARCHIVING AND COMMUNICATION SYSTEM **9**

Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical Issues, PACS architecture.

APPLICATIONS OF TELEMEDICINE **9**

Tele radiology, tele pathology, tele cardiology, tele oncology, tele dermatology, tele surgery, e Health and Cyber Medicine.

Total Periods: **45**

Text Books:

1. Norris A C, ―Essentials of Telemedicine and Telecare‖, John Wiley, New York, 2002.
2. H K Huang, ―PACS and Imaging Informatics: Basic Principles and Applications‖ Wiley, New Jersey, 2010.

References:

1. Olga Ferrer Roca, Marcelo Sosa Iudicissa, ―Handbook of Telemedicine‖, IOS Press, Netherland, 2002.
2. Khandpur R S, ―Handbook of Biomedical Instrumentation‖, Tata McGraw Hill, New Delhi, 2003.
3. Keith J Dreyer, Amit Mehta, James H Thrall, ―Pacs: A Guide to the Digital Revolution‖, Springer, New York, 2002.
1. 4. Khandpur R S, ―TELEMEDICINE – Technology and Applications‖, PHI Learning Pvt Ltd., New Delhi, 2017

191OE902

SPEECH PROCESSING

L	T	P	C
3	0	0	3

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**

Aim: To study the computation and use of techniques such as short time Fourier transform, linear predictive coefficients and other coefficients in the analysis of speech

Course Outcomes: The Students will be able to

CO1: Analyze speech recognition and synthesis techniques

CO2: Ability to use speech related parameters.

CO3: Identify the different speech modelling procedures such as Markov and their implementation issues

CO4: Develop artificial speech generation of human speech.

CO5: Make use of speech related parameters.

CO6: Ability to extract significant features from speech to reduce redundancy in speech by using several distortion measures.

BASIC CONCEPTS **10**

Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

SPEECH ANALYSIS **10**

Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

SPEECH MODELING **8**

Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

SPEECH RECOGNITION **8**

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent subword units; Applications and present status.

SPEECH SYNTHESIS **9**

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

Total Periods: **45**

Text Books:

1. Lawrence Rabinerand Biing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introduction toNatural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education, 3rd Edition, 2018.

References:

1. Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press, Reprint 2001.
2. Steven W. Smith, "The Scientist and Engineer‘s Guide to Digital Signal Processing", California Technical Publishing, 1997.

3. Thomas F Quatieri, "Discrete-Time Speech Signal Processing Principles and Practice", Pearson Education, 2004.
4. Claudio Becchetti and LucioPrinaRicotti, "Speech Recognition", John Wiley and Sons, 1999.
5. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing and Perception of Speech and Music", Wiley- India Edition, 2006 Edition.
6. Andrew Webb, ―Statistical Pattern Recognition‖, Wiley International, Second Edition, 2002.

		L	T	P	C
191OE903	**WEARABLE SYSTEMS**	**3**	**0**	**0**	**3**

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**
Aim: To study the sensor and signal processing requirement of wearable systems.

Course Outcomes: The Students will be able to

CO1: Design basic wearable systems for medical applications
CO2: Appreciate the need for BAN and the challenges involved in the design of BAN
CO3: Choose appropriate sensors and signal processing techniques for wearable systems
CO4: Comprehend and appreciate the significance and role of this course in the present contemporary world
CO5: Assess the energy requirement for a wearable system and analyse and experiment energy harvesting techniques for wearable systems
CO6: know the level of energy involvement in wearable systems

SENSORS **9**

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

SIGNAL PROCESSING **9**

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

ENERGY HARVESTING FOR WEARABLE DEVICES **9**

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

WIRELESS HEALTH SYSTEMS **9**

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication techniques

APPLICATIONS OF WEARABLE SYSTEMS **9**

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, Multi parameter monitoring, Neural recording, Gait analysis, Sports Medicine, Smart Fabrics

Total Periods: 45

Text Books:

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

References:

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

191OE904 **INTERNET OF THINGS IN MEDICINE**

L	T	P	C
3	0	0	3

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**
Aim: Build simple IoT Systems using Arduino and Raspberry Pi.

Course Outcomes:The Students will be able to

CO1: Develop IoT infrastructure for popular applications
CO2: Analyze various protocols for IoT.
CO3: Apply data analytics and use cloud offerings related to IoT.
CO4: Design a PoC of an IoT system using Rasperry Pi/Arduino.
CO5: Analyze applications of IoT in real time scenario
CO6: Know the concept of internet of things.

FUNDAMENTALS OF IoT **9**

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

IoT PROTOCOLS **9**

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT

DESIGN AND DEVELOPMENT **9**

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming

DATA ANALYTICS AND SUPPORTING SERVICES **9**

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG

APPLICATIONS OF IOT IN MEDICINE **9**

NSUM Technique for Diabetes Patients, Healthcare Monitoring system through Cyber-physical system, An IoT Model for Neuro sensors, AdaBoost with feature selection using IoT for somatic mutations evaluation in Cancer, A Fuzzy-Based expert System to diagnose Alzheimer's Disease, Secured architecture for IoT enabled Personalized Healthcare Systems, Healthcare Application Development in Mobile and Cloud Environments, Approach to predict Diabetic Retinopathy through data analytics, Diagnosis of chest diseases using artificial neural networks.

Total Periods: 45

Text Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.
2. Venkata Krishna, Sasikumar Gurumoorthy, Mohammad S. Obaidat, "Internet of Things and Personalized Healthcare Systems", Springer Briefs in Applied Sciences, and Technology, Forensic and Medical Bioinformatics, 2019.

References:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
2. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.
3. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
5. Michael Margolis, Arduino Cookbook, “Recipes to Begin, Expand, and Enhance Your Projects”, O'Reilly Media, 2nd Edition.

191OE905	**BRAIN COMPUTER INTERFACE AND ITS APPLICATIONS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**

Aim: To Study the various signal acquisition methods of BCI.

Course Outcomes: The Students will be able to

CO1: Evaluate concept of Brain computer interface.

CO2: Comprehend and appreciate the significance and role of this course in the present contemporary world.

CO3: Assign functions appropriately to the human and to the machine

CO4: Select appropriate feature extraction methods

CO5: Make Use of machine learning algorithms for translation

CO6: Identify the various machine learning methods of BCI.

INTRODUCTION TO BCI **9**

Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous -Invasive BCI -Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI.

BRAIN ACTIVATION **9**

Brain activation patterns - Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks

FEATURE EXTRACTION METHODS **9**

Data Processing – Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering -Principal Component Analysis (PCA), Independent Component Analysis

MACHINE LEARNING METHODS FOR BCI **9**

Classification techniques –Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF‘s, Perceptron‘s, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis

APPLICATIONS OF BCI **9**

Case Studies - Invasive BCIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor and robotic control using multi electrode array implant, Cortical control of muscles via functional electrical stimulation. Non-invasive BCIs:P300 Mind Speller, Visual cognitive BCI, Emotion detection. Ethics of Brain Computer Interfacing.

Total Periods: 45

Text Books:

1. Rajesh.P.N.Rao, ―Brain-Computer Interfacing: An Introduction‖, Cambridge University Press, First edition, 2013.
2. Jonathan Wolpaw, Elizabeth Winter Wolpaw, ―Brain Computer Interfaces: Principles and practice‖, Oxford University Press, USA, Edition 1, January 2012.

References:

1. Ella Hassianien, A &Azar.A.T (Editors), ―Brain-Computer Interfaces Current Trends and Applications‖, Springer, 2015.
2. Bernhard Graimann, Brendan Allison, GertPfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
3. Ali Bashashati, MehrdadFatourechi, Rabab K Ward, Gary E Birch,‖ A survey of signal Processing algorithms in brain–computer interfaces based on electrical brain signals‖ Journal of Neural Engineering, Vol.4, 2007, PP.32-57
4. Arnon Kohen, ―Biomedical Signal Processing‖, Vol I and II, CRC Press Inc, Boca Rato, Florida.
5. Bishop C.M., ―Neural networks for Pattern Recognition‖, Oxford, Clarendon Press, 1995.

191BME01 **BIO MEMS** **L T P C**
3 0 0 3

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**
Aim: Study the various MEMS fabrication techniques

Course Outcomes: The Students will be able to
CO1: Know the application of MEMS in different field of medicine.
CO2: Identify different types of sensors and actuators and their principles of operation at the micro scale level.
CO3: Determine the various MEMS fabrication techniques.
CO4: Explain different types of sensors and actuators and their principles of operation at the micro Scale level
CO5: Apply MEMS in different field of medicine .
CO6: List out the applications of BIOMEMS

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

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

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

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

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

Total Periods: **45**

Text Books:

1. Tai Ran Hsu, ―MEMS and Microsystems Design and Manufacture‖, Tata McGraw Hill Publishing Company, New Delhi, 2002. (Unit I, II, III & IV).
2. Wanjun Wang, Stephen A.Soper, ‖BioMEMS: Technologies and Applications‖, CRC Press, New York, 2007.(Unit V).

References:

1. Marc J. Madou ―Fundamentals of Microfabrication: the Science of Miniaturization‖, CRC Press,2002.

2. Nadim Maluf, Kirt Williams. ―An introduction to Microelectro Mechancial Systems Engineering‖, Second Edition, Artech House Inc, MA, 2004.
3. Chang Liu,‘ Foundations of MEMS‘, Pearson Education International, New Jersey, USA,2006
4. 4. Nitaigour Premchand Mahalik, ―MEMS‖, Tata McGraw Hill Publishing Company, New Delhi, 2007

191BME02

L	T	P	C
3	0	0	3

NANOTECHNOLOGY AND APPLICATIONS

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**

Aim: To provide a broad view of the nascent field of nanoscience and nanotechnology to undergraduates

Course Outcomes: The Students will be able to

CO1: Interpret the creation, characterization, and manipulation of nanoscale materials.

CO2: Organize the basic science behind the properties of materials

CO3: Apply their knowledge of nanotechnology to identify how they can be exploited for new applications.

CO4: List out the properties and measurement of Nanomaterials.

CO5: Explain the basics of nanomaterial synthesis and characterization

CO6: List out the applications of nanotechnology

INTRODUCTION TO NANOTECHNOLOGY **9**

Basic Structure of Nanoparticles- Kinetics in Nanostructured Materials- Zero dimensional, size and shape of nanoparticles; one-dimensional and two dimensional nanostructures- clusters of metals and semiconductors, bio Nano-particles

FABRICATION AND CHARACTERIZATION OF NANOMATERIALS **9**

Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Bucky balls, Nanotubes); Gas, liquid, and solid –phase synthesis of nanomaterials; Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials.

PROPERTIES AND MEASUREMENT OF NANOMATERIALS **9**

Optical Properties: Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.

NANO STRUCTURES **9**

Carbon Nanotubes, Fullerenes, Nanowires, Quantum Dots. Applications of nanostructures. Reinforcement in Ceramics, Drug delivery, Giant magnetoresistance, etc. Cells response to Nanostructures.

APPLICATIONS OF NANOTECHNOLOGY **9**

Nano electronics, Nano sensors, Nanotechnology in Diagnostics applications, Environmental and Agricultural Applications of nanotechnology, Nano technology for energy systems

Total Periods: **45**

Text Books:

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

References:

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

191BME03 **BIO MATERIALS AND ARTIFICIAL ORGANS** **L T P C**
3 0 0 3

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**

Aim: To study the compatibility and functioning of artificial organs inside the living system.

Course Outcomes: The Students will be able to

CO1: Choose materials for design of implants in tissue replacement.

CO2: Analyze different types of materials and its application in biomedical field.

CO3: Evaluate response of biomaterials in living system.

CO4: Assess compatibility and functioning of artificial organs inside the living system.

CO5: Design and develop biomaterial based scaffold for biomedical application

CO6: Know about the polymeric materials and composites in tissue replacements.

STRUCTURE OF BIO-MATERIALS AND BIO-COMPATIBILITY **9**

Definition and classification of bio-materials, mechanical properties, visco elasticity, wound-healing process, body response to implants, blood compatibility, HLA compatibility.

IMPLANT MATERIALS **9**

Metallic implant materials, stainless steels, Ti-based alloys, ceramic implant materials, aluminium oxides, hydroxyapatite, glass ceramics, carbons, medical applications.

POLYMERIC IMPLANT MATERIALS **9**

Polymerization, polyamides, Acrylic polymers, Hydrogels, rubbers, high strength, thermoplastics, medical applications. Bio polymers: collagen and elastin. Medical Textiles: silica, chitosan, PLA, composites, Sutures, wound dressings. Materials for ophthalmology: contact lens, Intra ocular lens. Membranes for plasma separation and blood oxygenation.

TISSUE REPLACEMENT IMPLANTS **9**

Small intestinal submucosa and other decellularized matrix biomaterials for tissue repair. Soft-tissue replacements, types of transplant by stem cell, sutures, surgical tapes, Tissue adhesive/glue. Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, Pancreas replacement

ARTIFICIAL ORGANS **9**

Artificial Blood, Artificial Skin, Artificial Heart, Prosthetic Cardiac valves, Artificial Lung(Oxygenator), Artificial Kidney (Dialyzer Membrane), Dental Implants, Retinal Implants

Total Periods: **45**

Text Books:

1. Sujata V. Bhatt, “Biomaterials”, Narosa Publishing House, 7th Edition, 2005.
2. JoonB.Park Joseph D. Bronzino, “Biomaterials - Principles and Applications”, CRC press, 2003.

References:

1. H.H.Willard,D.L.Merrit, “ “Instrumental Methods of Analysis”,CBS Publishers, 1992.
2. ParkJ.B., “Biomaterials Science and Engineering’’, Plenum Press,1984.
3. Myer Kutz, “ “Standard Handbook of Biomedical Engineering & Design”, McGraw-Hill, 2003
4. John Enderle, Joseph D.Bronzino, Susan M.Blanchard, “”Introduction to Biomedical Engineering”, Elsevier, 2005.
5. AC Anand, JF Kennedy, M. Miraftab, S.Rajendran, “Medical Textiles and Biomaterials for Health Care’’, Woodhead Publishing Limited, 2006.
6. D F Williams, “””Medical and Dental Materials: A comprehensive Treatment-Volume 14”, VCH Publishers, 1992.
7. BD Ratner, AS Hoffmann,FJ Schoen, JE Lemmons, “”An introduction to Materials in Medicine”, Academic Press, 1996.

191BME04 **BIO SIGNAL PROCESSING** **L T P C**
3 0 0 3

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**

Aim: To study and Understand choice of filters to remove noise and artifacts from biomedical signals

Course Outcomes: The Students will be able to

CO1: Label different types of biomedical signals and identify their spectral components
CO2: Make Use of different filters on biomedical signals and judge filter performance.
CO3: Identify physiological interferences and artifacts affecting ECG signal
CO4: Compute power and correlation spectra of EEG signal
CO5: Propose an algorithm to classify biomedical signals
CO6: Analyse various biomedical signals through advanced techniques.

INTRODUCTION TO BIOMEDICAL SIGNALS **9**

Bio signal Characteristics of Electro Cardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Electrogastrogram (EGG), Electroneurogram (ENG), Event related potentials (ERPs), Phonocardiogram (PCG), Speech signal, Objectives of Biomedical signal analysis, Difficulties in Biomedical signal analysis, Computer-aided diagnosis.

FILTERING FOR REMOVAL OF ARTIFACTS **9**

Time-domain Filters - synchronized averaging, Moving Average Filters, Derivative-based operators to remove low-frequency artifacts. Frequency-domain filters - Removal of High Frequency noise, Removal of low frequency noise, Removal of periodic artifacts, optimal filter- Wiener filter, Adaptive filters for removal of interference

CARDIOVASCULAR APPLICATIONS **9**

Noise & Artifacts, ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection, Adaptive noise cancelling in ECG, improved adaptive filtering in FECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets. Computation of diagnostic signal parameters of ECG like Heart rate and QRS detection using Multivariate analysis (PCA and ICA). Segmentation of PCG, intensity patterns, Spectral modelling and analysis of PCG signals.

NEUROLOGICAL APPLICATIONS **9**

EEG rhythms & waveforms, EEG applications- Epilepsy, sleep disorders, brain computer interface. Modeling EEG- linear, stochastic models - Nonlinear modelling of EEG - artifacts in EEG & their characteristics and processing – Nonparametric spectral analysis, Model based spectral analysis - EEG segmentation - Joint Time-Frequency analysis - correlation analysis of EEG channels - coherence analysis of EEG channels. Evoked potentials- noise characteristics, Noise reduction by linear filtering.

ANALYSIS ON WAVESHAPE, SIGNAL CLASSIFICATION AND RECOGNITION **9**

Modelling intramuscular EMG-Intramuscular signal decomposition-Fractal analysis of EMG signals. Statistical analysis of VAG signals. Analysis on amplitude and latency of MEG signals. Analysis of ERP effect. Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Analysis of EEG using Empirical mode decomposition (EMD).

Total Periods: **45**

Text Books:

1. Rangayyan, ―Biomedical Signal Analysis‖, Wiley 2002.
2. Semmlow, ―Biosignal and Biomedical Image Processing‖, Marcel Dekker, 2004

References:

1. Arnon Cohen, ―Bio-Medical Signal Processing Vol I and Vol II‖, CRC Press Inc., Boca Rato, Florida 1999.
2. D.C.Reddy, ―Biomedical Signal Processing: Principles and techniques‖ , Tata McGraw Hill, New Delhi, 2005
3. Willis J Tompkins, ―Biomedical Digital Signal Processing‖, Prentice Hall, 1993
4. Bruce, ―Biomedical Signal Processing & Signal Modeling,‖ Wiley, 2001
5. Sörnmo, ―Bioelectrical Signal Processing in Cardiac & Neurological Applications‖, Elsevier 2005.

191BME05 **BIOFLUIDS AND DYNAMICS** **L T P C**
3 0 0 3

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**

Aim: To study the mathematical modelling of fluid biological system

Course Outcomes: The Students will be able to

CO1: Analyse cellular, ocular, cardiovascular and respiratory fluid mechanics
CO2: Develop mathematical models of biological systems with fluids
CO3: Elaborate on cardiorespiratory mechanics and space medicine
CO4: Examine the intracellular fluid mechanics and ocular mechanics.
CO5: Know the concept basics of Fluid Mechanics
CO6: Describe the rheology of blood and mechanics of blood vessels.

BIOFLUID MECHANICS **8**

Intrinsic fluid properties - Density, Viscosity, Compressibility, Surface tension, Hydrostatics Fluid characteristics and viscosity – Displacement and velocity, Sheer stress and viscosity Bernoulli equation, Introduction to pipe flow – Reynolds number, Poiseuille's law, Flow Rate, Womersley number, Constitutive equations – Newtonian fluid, Non-Newtonian viscous fluid, Diameter, velocity and pressure of blood flow relationship, Resistance against flow, Viscoelasticity – Viscoelastic models, Response to Harmonic variation, Use of viscoelastic models, Bio-Viscoelastic fluids – Protoplasm, Mucus, Saliva, Synovial fluids

CELLULAR AND OCCULAR MECHANICS **8**

Cellular Biomechanics – Eukaryotic cell architecture, Cytoskeleton, Cell-matrix interactions, Mechanical property measurement – Atomic Force microscopy, Optical Trapping, Magnetic bead microrheometry, Micropipette aspiration, Models of cellular biomechanical behavior, Computational model of a chondrocyte in its matrix, Mechanotransduction, Techniques for mechanical stimulation of the cells, Tissue cell mechanobiology – Endothelial, smooth muscle cells, Chondrocytes, Osteoblasts, Ocular Biomechanics – Occular anatomy, Biomechanics of Glaucoma, Ocular blood flow. .

BLOOD RHEOLOGY AND BLOOD VESSEL MECHANICS **10**

Viscometry, Elements of Blood, Blood characteristics – Viscosity of blood, Einstein's equation, Biomechanics of red cell membrane, Apparent and relative viscosity, Blood viscosity variation,Casson"s equation, Rheology of Blood In Micro vessels – Fahraeus-Lindquist effect and its inversion, Anatomy and physiology of blood vessels, Arterial wall as membrane – Uniaxial loading, Biaxial loading, Torsion, Hemodynamics of Large arteries – Ventricular outflow and the aorta, Pressure-flow relations and Vascular Impedance, Wave propagation and reflection

CARDIO RESPIRATORY MECHANICS AND SPACE MEDICINE **9**

Cardiac cycle – Pressure volume diagrams, Changes in contractility, Ventricular performance, Congestive heart failure, Pulsality index, Physics of valvular diseases, Prosthetic heart valves and replacements, Respiratory System – Alveolar ventilation-lung volumes and capacities, Mechanics of breathing, Work of breathing – Lung compliance, Airway resistance, Gas exchange and transport, Oxygen dissociation curve, Lung surfactant, Pulmonary pathologies, Space Medicine – Hypoxia, Physiology of decompressive sickness, Human response to acceleration, Thermal Stress

COMPUTATIONAL FLUID DYNAMICS **10**

Computational fluid dynamics – CFD Code, Problem solving with CFD, Conservation Laws of Fluid Motion and Boundary Conditions, Turbulence and its modelling, The Finite Volume Method for Diffusion Problems and Convection-Diffusion Problems, Solution Algorithms for Pressure-Velocity Coupling in steady flows, Solution of Discretized Equations, The Finite

Volume Method for Unsteady flows, Implementation of Boundary Conditions Application – Multiphysics computational models for cardiac flow and virtual cardiography.

Total Periods: 45

Text Books:

1. Krishnan B. Chandran, Ajit P. Yoganathan, Stanley E. Rittgers, ―Biofluid Mechanics- The human circulation‖, CRC Taylor and Francis, 2007.
2. Y.C Fung, ―Biomechanics- Mechanical properties of living tissues‖, 2nd Edition, Springer-Verlag, 1993.
3. Jeffery R. Davis et. Al., ―Fundamentals of Aerospace Medicine‖, Wolter Kluwer Health, Lippincott Williams and Wilkins, 2008

References:

1. Jung HeeSeo, Vijay Vedula, Theodore Abraham and Rajat Mittal, ―Multiphysics computational models for cardiac flow and virtual cardiography‖, Int. J. Numer. Meth. Biomed. Engng. (2013) Published online in Wiley Online Library
2. Lee Waite, Jerry Fine, ―Applied Biofluid Mechanics‖, McGraw Hill, 2007
3. John K-J Li, ―Dynamics of Vascular System‖, World Scientific, 2004
4. C. Ross Ethier, Craig A Simmons, ―Introduction to Biomechanics- From Cells to Organisms‖, Cambridge Texts in Biomedical Engineering, 2007
5. H K Versteeg, W Malalasekera, ―An Introduction to Computational Fluid Dynamics The Finite Volume Method‖, Longman Scientific and Technical, 1995

191BME06 **PHYSIOLOGICAL MODELING** **L T P C**
3 0 0 3

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**

Aim: To study the dynamic models, simulate and visualize, dynamic responses of physiological models using software.

Course Outcomes: The Students will be able to

CO1: Formulate the methods and techniques for analysis and synthesis of dynamic models
CO2: Explain the application of Physiological models and vital organs
CO3: Categorize the Simulation of physiological systems
CO4: Develop differential equations to describe the compartmental physiological model
CO5: Illustrate the Simulation of physiological systems
CO6: Describe Nonlinear models of physiological systems.

INTRODUCTION TO PHYSIOLOGICAL MODELING **9**

Approaches to modeling: The technique of mathematical modeling, classification of models, characteristics of models. Time invariant and time varying systems for physiological modeling.Introduction to physiology (homeostasis, cell biology) Modeling physicalsystems, linearmodels of physiological systems,the Laplace transform, Transfer functions and block diagram analysis Physiology

MODELING OF DYNAMIC PHYSIOLOGICAL SYSTEM **9**

Dynamic systems and their control, modeling and block diagrams, the pupil control systems(Human Eye), general structure of control systems, the dynamic response characteristics of the pupil control system, open &close loop systems instability, automatic aperture control

NONLINEAR MODELS OF PHYSIOLOGICAL SYSTEMS **9**

Nonparametric Modeling-Volterra Models.Wiener Models. Efficient Volterra Kernel Estimation.Parametric Modeling- Basic Parametric Model Forms and Estimation Procedures-Volterra Kernels of Nonlinear Differential Equations. Discrete-Time Volterra Kernels of NARMAX Models.

COMPARTMENTENTAL PHYSIOLOGICAL MODEL **9**

Modeling the body as compartments, behaviour in simple compartmental system, pharmacokinetic model, and multi compartmental system. Physiological modeling: Electrical analogy of blood vessels, model of systematic blood flow and model of coronary circulation.Mathematical modeling of the system: Thermo regulation, Thermoregulation of cold bloodedness& warm bloodedness, the anatomy of thermo regulation, lumping & partial differential equations, heat transfer examples, mathematical model of the controlled process of the body. .

SIMULATION OF PHYSIOLOGICALSYSTEMS **9**

Simulation of physiologicalsystemsusing Open CV / MATLAB software. Biological receptors: -Introduction, receptor characteristics, transfer function models of receptors, receptor and perceived intensity. Neuromuscular model, Renal System, Drug Delivery Model.

Total Periods: **45**

Text Books:

1. Michel C Khoo, ―Physiological Control Systems -Analysis, simulation and estimation‖, Prentice Hall of India, 2001.
2. Marmarelis, ―Nonlinear Dynamic Modeling of Physiological Systems‖, Wiley-IEEE Press,2004.

References:

1. Benjamin C Kuo, ―Automatic control systems‖, Tenth Edition, McGraw-Hill Education, 2017.

2. DavidTWestwick, Robert E. Kearney, Identification of Nonlinear PhysiologicalSystems, Wiley-IEEE Press, 2003.
3. V.Z. Marmarelis, ―Advanced methods of physiological modeling‖ , *Springer*, 1989
4. L.Stark,‖ Neurological Control System, Plenum Press‖,1968.
5. John H Milsum , ―Biological control systems‖, McGraw Hill 1966
6. MinruiFei, Shiwei Ma, Xin Li, Xin Sun, Li Jia and Zhou Su,―Advanced Computational Methods in Life System Modeling and Simulation‖, *Springer*,2017

191BME07 **SOFT COMPUTING TECHNIQUES** **L T P C**
3 0 0 3

Programme: B.E. Biomedical Engineering **Sem:** 3 **Category:** ESC

Aim: To study the neural network architectures and learning algorithms, for different applications

Course Outcomes: The Students will be able to

CO1: Describe various neural, fuzzy and Genetic algorithms.
CO2: Influence of Neural, Genetic and Fuzzy algorithms for various classification applications
CO3: Explore the use of Fuzzy and Genetic Algorithm
CO4: Importance of Hybrid and Other advanced model in soft computing.
CO5: Identify the different Optimization techniques in soft computing
CO6: function of adaptive resonance theory and self- organizing map.

FROM BIOLOGY TO ARTIFICIAL NEURAL NETWORKS – 9
INTRODUCTION

Biological Neural Networks, Components of Artificial Neural Networks – Connections, Propagation function and Network Inputs, Common Activation Functions, Threshold, Network Topologies, Learning - Supervised, Unsupervised, Reinforcement. Backpropagation, Radial Basis Function, Self-Organizing Maps, Counter Propagation Networks, Adaptive Resonant Theory (ART).

FUZZY SET THEORY **10**

Introduction to Fuzzy – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modelling.

GENETIC ALGORITHM **9**

Genetic Algorithms: Introduction to Genetic Algorithms (GA), Representation, Operators in GA, Fitness function, population, building block hypothesis and schema theorem.; Genetic algorithms operators methods of selection, crossover and mutation, simple GA (SGA), other types of GA, generation gap, steady state GA.

OPTIMIZATION USING SOFT COMPUTING **9**

Single variable optimization - Region Elimination Methods, Fibonacci Search Method, Multivariable Optimization - Cauchy's Steepest Descent Method, Newton's method, Swarm Intelligence-Particle Swarm Optimization, ANT Intelligence – ANT Colony Optimization, Artificial Bee Colony Algorithm, Jumping Frog Optimization .

HYBRID AND ADVANCED MODEL IN SOFT COMPUTING **8**

Genetic Algorithm based Back propagation Network, Fuzzy Logic Controlled Genetic Algorithms, Neuro-fuzzy hybrid systems, Support Vector Machine, Extreme Learning Machine (ELM), Extended ELM, Random Forest Algorithm

Total Periods: **45**

Text Books:

1. J.S.R.Jang, C.T.Sun and E.Mizutani, ―Neuro-Fuzzy and Soft Computing‖, PHI, 2004, Pearson Education 2004.
2. James A Freeman and David M.Skapra, ―Neural Networks: Algorithms, Applications, and Programming Techniques‖, Addison-Wesley, 1991, Digital Version 2007.
3. Davis E.Goldberg, ―Genetic Algorithms: Search, Optimization and MachineLearning‖, Addison Wesley, N.Y., 1989

References:

1. LaureneFausett, ―Fundamentals of neural networks- Architectures, algorithms and applications‖, Prentice Hall, 1994.
2. Simon O. Haykins,‖Neural Networks: A Comprehensive Foundation‖, 2nd Edition, Pearson 1994
3. Zimmermann H.J. "Fuzzy set theory and its Applications" Springer international edition, 2011.

191BME08 **NEURAL ENGINEERING**

L	T	P	C
3	0	0	3

ESC

Programme: B.E. Biomedical Engineering **Sem:** 3 **Category:**

Aim: To study the various techniques to study central and peripheral nerve function.

Course Outcomes: The Students will be able to

CO1: Examine the Evoked potentials and its importance in medicine.

CO2: Discuss the electrophysiological evaluation in special situations.

CO3: Differentiate between a normal and abnormal signal coming from a healthy and a diseased nervous system respectively.

CO4: Identify the various techniques that are used to evaluate the functioning of central and peripheral nervous system.

CO5: Know the concept of physiology behind generation of nerve impulses.

CO6: Importance of various techniques to study central and peripheral nerve function

NERVE EXCITABILITY AND ELECTROMYOGRAPHY 8

Nerve Excitability: Functional insights derived from axonal structures, Nerve excitability findings in Neurologic diseases: Chemotherapy induced neurotoxicity, Porphyric Neuropathy, Inflammatory Neuropathy and its Treatment, Spinal Cord Injury; Nerve conduction studies, Microneurography and its potential clinical applications.Clinical Electromyography (EMG), Quantitative EMG,Neuromuscular Ultrasound as a compliment to the electrodiagnostic evaluation, Electrophysiologic study of Disorders of Neuromuscular Junction:, H-Reflex and F-Reflex, Blink reflex and other cranial nerve reflexes, Electrophysiological evaluation of movement disorders, Evaluation of autonomic nervous system.

ELECTROENCEPHALOGRAPHY 10

Electroencephalography (EEG): General Principles and Clinical Applications, Neonatal and Paediatric EEG, EEG Artefacts and Benign Variants, Video EEG monitoring for epilepsy, Invasive Clinical Neurophysiology in Epilepsy and movement disorders, Topographic mapping, Frequency analysis and other quantitative techniques in EEG, Intraoperative EEG monitoring during carotid endarterectomy and cardiac surgery, Magnetoencephalography

EVOKED POTENTIALS 9

Evoked Potentials and Related Techniques: Visual Evoked potentials (VEPs), Electroretinography and other diagnostic approaches to the Visual System, VEPs in infants and children, Brainstem Auditory Evoked Potentials (AEPs), Brainstem AEPs in infants and children, Somatosensory evoked potentials, Diagnostic and therapeutic role of Magnetic stimulation in neurology

FUNCTIONAL NEUROIMAGING AND COGNITION 9

Historical and physiological perspective, Functional neuroimaging methods: PET and fMRI, Network analyses, Functional neuroimaging of: Attention, Visual recognition, Semantic memory, Language, Episodic memory, Working memory, Cognitive aging, Neuro-psychologically impaired patients

ELECTROPHYSIOLOGICAL EVALUATION IN SPECIAL SITUATIONS 8

Electrophysiological evaluation of sacral function: Bladder, bowel and sexual function, Vestibular laboratory testing, Polysomnographic evaluation of sleep disorders, Electrophysiologic evaluation of: brain death, patients in the intensive care unit, patients with suspected neurotoxic disorders.

Total Periods: 45

Text Books:

1. Michael J. Aminoff, et. al., ―Aminoff‘selectrodiagnosis in Clinical Neurology‖, Sixth Edition, Elsevier Saunders, 2012.

2. Kim E. Baretteet. al., ―Ganong‘s review of Medical Physiology‖, 23rd Edition, McGraw Hill Medical, 2010

References:

1. Eric R. Kandelet. al., ―Principles of Neural Science‖ ,McGraw-Hill, New York, 2012.
2. R. Cooper, et. al, ―Techniques in Clinical Neurophysiology: A Practical Manual , Elsevier, Amsterdam, The Netherlands, 2005.
3. Holodny, Andrei I., et al, ―Functional neuroimaging: a clinical approach‖. Informa Health Care, 2008

191BME09 **BIOMETRIC SYSTEMS** **L T P C**
3 0 0 3
ESC

Programme: B.E. Biomedical Engineering **Sem:** **3** **Category:**

Aim: To study the recognize personal privacy and security implications of biometrics based identification technology.

Course Outcomes: The Students will be able to

CO1: Demonstrate knowledge engineering principles underlying biometric systems.
CO2: Analyze design basic biometric system applications.
CO3: Identify issues in the realistic evaluation of biometrics based systems
CO4: Know the concept of technologies in fingerprint, iris, face and speech recognition
CO5: Identify the general principles of design of biometric systems and the underlying trade-offs.
CO6: Design a multi-biometric systems.

INTRODUCTION TO BIOMETRICS **9**

Introduction and back ground – biometric technologies – passive biometrics – active biometrics - Biometrics Vs traditional techniques – Benefits of biometrics - Operation of a biometric system– Key biometric processes: verification, identification and biometric matching – Performance measures in biometric systems: FAR, FRR, FTE rate, FTA rate and rate- Need for strong authentication – Protecting privacy and biometrics and policy – Biometric applications

FINGERPRINT IDENTIFICATION TECHNOLOGY **9**

Fingerprint Patterns, Fingerprint Features, Fingerprint Image, width between two ridges - Fingerprint Image Processing - Minutiae Determination - Fingerprint Matching: Fingerprint Classification, Matching policies

FACE RECOGNITION **9**

Introduction, components, Facial Scan Technologies, Face Detection, Face Recognition, Representation and Classification, Kernel- based Methods and 3D Models, Learning the Face Spare, Facial Scan Strengths and Weaknesses, Methods for assessing progress in Face Recognition

VOICE SCAN **9**

Introduction, Components, Features and Models, Addition Method for managing Variability, Measuring Performance, Alternative Approaches, Voice Scan Strengths and Weaknesses, NIST Speaker Recognition Evaluation Program, Biometric System Integration.

FUSION IN BIOMETRICS **9**

Introduction to Multibiometric - Information Fusion in Biometrics - Issues in Designing a Multibiometric System - Sources of Multiple Evidence - Levels of Fusion in Biometrics - Sensor level, Feature level, Rank level, Decision level fusion - Score level Fusion. Examples – biopotential and gait based biometric systems

Total Periods: **45**

Text Books:

1. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, ―Biometric Systems, Technology Design and Performance Evaluation‖, Springer, 2005.
2. David D. Zhang, ―Automated Biometrics: Technologies and Systems‖, Kluwer Academic Publishers, New Delhi, 2000.
3. Arun A. Ross , Karthik Nandakumar, A.K.Jain, ―Handbook of Multibiometrics‖, Springer, New Delhi, 2006.

References:

1. Paul Reid, ―Biometrics for Network Security‖, Pearson Education, 2004.
2. Nalini K Ratha, Ruud Bolle, ―Automatic fingerprint Recognition System‖, Springer, 2003

3. L C Jain, I Hayashi, S B Lee, U Halici, ―Intelligent Biometric Techniques in Fingerprint and Face Recognition‖ CRC Press, 1999.
4. John Chirillo, Scott Blaul, ―Implementing Biometric Security‖, John Wiley, 2003.
5. S.Y. Kung, S.H. Lin, M.W.Mak, ―Biometric Authentication: A Machine Learning Approach‖Prentice Hall, 2005

191BME10 **MEDICAL ETHICS AND STANDARDS** **L T P C**
3 0 0 3

Programme: B.E. Biomedical Engineering **Sem: 3 Category: ESC**
Aim: To study the principles Patient safety and regulatory aspects followed in hospitals.

Course Outcomes: The Students will be able to

CO1: know about the legal and ethical principles in health care settings & gain knowledge about the medical standards that to be followed in hospitals.
CO2: List out the Legal and professional guidelines for the health professions
CO3: Functions of Social responsibility in healthcare systems
CO4: Importance of Bioethics and engineers role
CO5: Explain the maintenance of Medical device.
CO6: Know the concept of safety aspects

INTRODUCTION TO MEDICAL ETHICS 9

Definition of Medical ethics, Scope of ethics in medicine, International code of Ethics for occupational health professionals, Ethical Theories --Deontology & Utilitarianism ,Casuist theory, Virtue theory, The Right Theory. Role of ethics in Healthcare workplace – Autonomy, Non-Malfeasance, Beneficence, Veracity, Justice, OSHA, Decision Model for Healthcare Dilemmas-Applications of Plus decision making model.

CODE OF ETHICS FOR BIOMEDICAL ENGINEERS 9

Bioethics-The principle of Double effect, Code of Hammurabi, Engineering Competence, Ethical Issues in biomedical research-Cloning and stem cell research, Neuro ethics, Organ Transplantation, Hypothetico-deductive method, Research Conflict of Interest. Medical device failure- Five failure types, Bio-terrorism, Sustainable Bioethics-Life cycles and Concurrent Engineering, Environmental Health – case studies

MEDICAL DEVICE SAFETY 9

Shared Responsibility for Medical device safety. WHO – International Health Regulations (IHR), Stages of regulatory control of medical devices, Ethics committee- its members and functions, Global Harmonization Task Force (GHTF). Quality systems requirement –ISO, Voluntary and mandatory standards, Collateral Standards- EMC radiation protection &programmable medical device system, Particular Standards-type of medical device

REGULATORY STANDARDS FOR MEDICAL DEVICE MAINTENANCE 9

International Standards- Medical Device Directive 93/42/EEC, Medical Electrical Equipment ISO 60601, Safety Testing of Medical Devices ISO 62353, Medical Device Inspection ISO17020. Indian Standards – National Health Mission , Biomedical Equipment Management and Maintenance Program (BMMP), ISO 9001-2008, AERB Compliance – Radiation protection AE(RP)R-2004, Safety Code AE/RF-MED/SC-3.

HOSPITAL ACCREDITATION AND SAFETY STANDARDS 9

Accreditation - JCI Accreditation & its Policies.Life Safety Standards- Protecting Occupants, Protecting the Hospital and Individuals from Fire, Smoke, and Heat.Managing Hazardous Medical Material and Waste, Laboratory and Radiation safety, Health and safety hazards of shift work. Patient Safety – Human factors, Reliability, Evidence based Medicine, Root cause Analysis.

Total Periods: 45

Text Books:

1. William Charney, “Handbook of Modern Hospital Safety’’, CRC Press, 2nd Edition, 2009.
2. Almira Badnjevic, Mario Cifrek, Ratko Magjarevic, Zijad Dzemic, “Inspection of Medical Devices: For Regulatory Purposes”, Springer Nature, 2018.
3. Domiel A Vallero , “Biomedical Ethics for Engineers”, Elsevier Pub.1st Edition, 2007.

References:

1. Eileen E.Morrison, “Ethics in Health Administration: A Practical Approach for Decision Makers’’,Jonnes and Bartletts’ Publication, 2nd Edition, 2011.
2. Robert M Veatch, “Basics of Bio Ethics’’, Prentice- Hall, Inc., 2nd Edition, 2003.
3. Physical Environment Online: A Guide to The Joint Commission‘s Safety Standards is published by HCPro, Inc., 2010.
4. Joint Commission Accreditation Standards for Hospitals ,2nd Edition, 2003

191BME11 **BODY AREA NETWORKS** **L T P C**
3 0 0 3

Programme: B.E. Biomedical Engineering **Sem:** 3 **Category:** ESC

Aim: To study the basic hardware requirement of body area network

Course Outcomes: The Students will be able to

CO1: Design a BAN for appropriate application in medicine.

CO2: Assess the efficiency of communication and the security parameters.

CO3: Extend the concepts of BAN for medical applications

CO4: Identify the various effects on transmission

CO5: Identify the various types of wireless communication and network.

CO6: List out the applications of Body Area Network

INTRODUCTION **9**

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

HARDWARE FOR BAN **9**

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

WIRELESS COMMUNICATION AND NETWORK **9**

RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee

COEXISTENCE ISSUES WITH BAN **9**

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

APPLICATIONS OF BAN **9**

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill. .

Total Periods: **45**

Text Books:

1. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.

2. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability’’, Cambridge University Press, 2013.

References:

1. Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems’’, Springer, 2013.

2. Guang-Zhong Yang(Ed.), “Body Sensor Networks’’, Springer, 2006.

3. Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012.

		L	T	P	C
191BME12	**REHABILITATION ENGINEERING**	**3**	**0**	**0**	**3**

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**
Aim: To study the orthopaedic and prosthetics in rehabilitation.
Course Outcomes: The Students will be able to
CO1: Design and develop different sensory assist devices, orthotics and prosthetics for rehabilitation applications
CO2: List out the virtual reality tools for different aids.
CO3: Appreciate the legal aspects for building rehabilitation aids for the needed people.
CO4: concepts for future development and applications
CO5: Know the basic concepts of sensory augmentation.
CO6: Develop rehabilitation medicine and advocacy.

INTRODUCTION **9**

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

ENGINEERING CONCEPTS IN SENSORY REHABILITATION ENGINEERING **9**

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

ORTHOPEDIC PROSTHETICS AND ORTHOTICS IN REHABILITATION **9**

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

VIRTUAL REALITY IN REHABILITATION **9**

Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation. .

REHABILITATION MEDICINE AND ADVOCACY **9**

Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life.

Total Periods: **45**

Text Books:

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

References:

1. Sashi S Kommu, “Rehabilitation Robotics”, 1st edition, CRC Press, 2007.
2. Sunder, “Textbooks of Rehabilitation”, Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007.
3. Horia- Nocholai Teodorecu, L.C.Jain, “Intelligent systems and technologies in rehabilitation Engineering”, CRC; December 2000.
4. Etienne Grandjean, Harold Oldroyd, “Fitting the task to the man”, Taylor & Francis,1988.

5. Keswick. J., “what is Rehabilitation Engineering, Annual Reviews of Rehabilitation”, Springer-Verlag, New York, 1982.
6. Warren E. Finn, Peter G. Lopressor, “Handbook of Neuroprosthetic Methods”,CRC, 2002.
7. Rory A Cooper (Editor), Hisaichi Ohnabe (Editor), Douglas A. Hobson (Editor), “An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering” CRC Press, 2006.

191BME13 **PRINCIPLES OF TISSUE ENGINEERING** **L T P C**
3 0 0 3

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**

Aim: To study the cell cycle and its differentiation.

Course Outcomes: The Students will be able to

CO1: Know the basic concepts of tissue engineering

CO2: Acquire ability to function on multi-disciplinary teams

CO3: Apply the knowledge of professional and ethical responsibility in use of stem cells and gene therapy in creating tissue engineered therapies

CO4: Design and develop different biomaterial in tissue engineering application.

CO5: Summarize research or clinical application on tissue repair/ engineering

CO6: Examine basics about stem cells and its applications

FUNDAMENTALS OF TISSUE ENGINEERING **9**

Tissue Engineering: Introduction - Objectives of tissue engineering - Laboratory set up for tissue engineering. Tissue development and Tissue exchange - Cell cycle and differentiation - cell adhesion - cell adhesion molecules - cell migration - cell aggregation and tissue equivalent. .

COMPONENTS OF TISSUE ENGINEERING **9**

Cell: Cell harvesting In Vitro – Medium: Synthetic and Biological media – Scaffold: Natural and Synthetic scaffold: Cell and Drug delivery systems - Transplantation – Implantation - Nanotechnology in tissue engineering – Biocompatibility studies In Vitro and In Vivo.

STEM CELLS **8**

Definition of stem cells – types of stem cells – differentiation, dedifferentiation maturation, proliferation, pleuripotency and immortalization. Sources of stem cells: haematopoetic – fetal - cord blood – placenta - bone marrow - primordial germ cells - cancer stem cells - induced pleuripotent stem cells

MATERIALS IN TISSUE ENGINEERING **9**

Biological materials – degradable and non degradable – extra cellular matrix-decellularization - Polymers: synthetic and natural – cell interaction with polymers – applications of polymer. Ceramics and Metals

APPLICATION OF TISSUE ENGINEERING **9**

Replacement Engineering: Bone, cartilage, skin, blood, pancreas, kidney, heart valve and liver. Regenerative engineering: peripheral Nerve regeneration – cardiac tissue regeneration – muscle regeneration – Tissue Engineered Food. Regulation, Commercialization and Patenting.

Total Periods: **45**

Text Books:

1. W. Mark Saltzman, “Tissue Engineering – Engineering principles for design of replacement organs and tissue”,Oxford University Press Inc New York, 2004.
2. CS Potten, “Stem cells”, Elsevier, 1996.

References:

1. Gary E. Wnek, Gary L Browlin , “Encyclopedia of Biomaterials and Biomedical Engineering”,Marcel Dekker Inc, New York, 2008.
2. R. Lanza, Anthony Atala (Eds), “Essential of Stem Cell Biology”, Academic Press, USA, 2013.
3. R. Lanza, Anthony Atala,“ Handbook of Stem Cells’’, Academic Press, USA, 2012.

191BME14	**CRYPTOGRAPHY AND NETWORK SECURITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**

Aim: To study the importance of security for networks.

Course Outcomes: The Students will be able to

CO1: Analyze to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: Importance of security for networks, use of number theory and Galois field concepts

CO3: Differentiate new symmetric and Asymmetric key crypto system

CO4: Develop new authentication and key management techniques

CO5: Illustrate & develop a new network security protocols

CO6: Infer security specific to network layer

NUMBER THEORETIC AND ALGEBRAIC ALGORITHMS **9**

Significance of network and data security in todays communication scenario – Overall Classification - Integer Arithmetic Modular Arithmetic – matrices – Linear congruence-

MODERN SYMMETRIC KEY CIPHERS **9**

Modern block ciphers – Modern stream ciphers – DES – AES – uses of modern block ciphers and stream cipher, Application Examples

ASYMMETRIC KEY ENCIPHERMENT **9**

Mathematics of cryptography – Primality Testing – Factorization – Chinese Remainder Theorem – Quadratic – Exponentiation & Logarithm – RSA, Rabin – Elliptic curve, Application Examples

INTEGRITY AUTHENTICATION AND KEY MANAGEMENT **9**

Message integrity – random oracle model – message authentication – SHA-512 – WHIRL POOL-Digital signature schemes Entity anthentication– password – challenge response – zero knowledge – Biometrics – Kerberos – symmetric key management – public key distribution – steganography, Application Examples

NETWORK SECURITY **9**

Security at the Application Layer: E-mail – PGP – S/MIME – Security at the transport layer: SSL and TLS – Security at the network layer: IPsec, Two Security Protocol – Security Association – Internet Key Exchange – ISAKMP, Application Examples.

Total Periods: **45**

Text Books:

1. Behrouz A. Ferouzan, "Cryptography & Network Security", 5th Edition, Tata McGraw Hill,.
2. W.Stallings, "Cryptography & Network Security: Principles and Practice", Prentice Hall, 4th Edition, 2003.

References:

1. Douglas R.Stlinson, "Cryptography Theory and Practice", CRC Press series on Discrete Mathematics and its application 1995.
2. Charlie Kaufman, Radia Perlman, Mike Speciner, "Network Security Private Communication in a Public World", Pearson Education, 2nd Edition, 2003.

191BME15 **ELECTRO MAGNETIC INTERFERENCE AND COMPATIBILITY** **L T P C 3 0 0 3**

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**

Aim: To gain the knowledge on the EMI coupling mechanism and its mitigation techniques

Course Outcomes: The Students will be able to

CO1: Define the comprehensive insight about the current EMC standards and about various measurement techniques

CO2: Explain the basics of EMI,EMC

CO3: Summarize the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues

CO4: Design a EMI free system

CO5: Outline high speed Printed Circuit board with minimum interference

CO6: Develop our world free from unwanted electromagnetic environment

BASIC CONCEPTS **7**

Definition of EMI and EMC; Intra and Inter system EMI; Sources and victims of EMI, Conducted and Radiated EMI emission and susceptibility; Transient & ESD; Case Histories; Radiation Hazards to humans

COUPLING MECHANISM **9**

Common made coupling; Differential mode coupling; Common impedance coupling; Ground loop coupling; Field to cable coupling; Cable to cable coupling; Power mains and Power supply coupling.

EMI MITIGATION TECHNIQUES **10**

Shielding – principle, choice of materials for H, E and free space fields, and thickness; EMI gaskets; Bonding; Grounding – circuits, system and cable grounding; Filtering; Transient EMI control devices and applications; PCB Zoning, Component selection, mounting, trace routing

STANDARDS AND REGULATION **7**

Units of EMI; National and International EMI Standardizing Organizations – IEC, ANSI, FCC, CISPR, BIS, CENELEC; FCC standards; EN Emission and Susceptibility standards and specifications; MIL461E Standards.

TEST METHODS AND INSTRUMENTATION **12**

Replacement Engineering: Bone, cartilage, skin, blood, pancreas, kidney, heart valve and liver. Regenerative engineering: peripheral Nerve regeneration – cardiac tissue regeneration – muscle regeneration – Tissue Engineered Food. Regulation, Commercialization and Patenting.

Total Periods: **45**

Text Books:

1. V.P. Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press,New york, 2nd Edition, 2010

2. Henry W.Ott., “Noise Reduction Techniques in Electronic Systems”, A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 2009.

References:

1. Don R.J.White Consultant Incorporate, “Handbook of EMI/EMC”, Vol I-V, 1988

2. Bemhard Keiser, “Principles of Electromagnetic Compatibility”, 3rd Edition, Artech house, Norwood, 1987

3. C.R. Paul, “Introduction to Electromagnetic Compatibility”, John wiley& sons Inc. 2006.

191BME16 **MULTIMEDIA COMPRESSION AND NETWORKS** **L T P C 3 0 0 3**

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**

Aim: To study the characteristics of text, voice, image and video data

Course Outcomes: The Students will be able to

CO1: Explain various compression schemes for text, voice, image and video & analyse the compression schemes

CO2: Utilize communication protocols for voice over internet and multimedia networking

CO3: Criticize the characterize the features of multimedia components

CO4: Relate & develop audio and video processing systems

CO5: Deduct develop compression algorithms for processing text and images.

CO6: Design the tackle network and the issues in the transmission of text, audio and video signals.

MULTIMEDIA COMPONENTS **9**

Introduction- Multimedia skills- Multimedia components and their characteristics- Text, sound, images, graphics, animation, video, hardware.

AUDIO AND VIDEO COMPRESSION **9**

Audio compression–DPCM-Adaptive DPCM –adaptive predictive coding-linear Predictive coding code excited LPC-perpetual coding –Video compression principles-H.261, H.263, MPEG 1, 2, 4.

TEXT AND IMAGE COMPRESSION **9**

Compression principles-source encoders and destination encoders-lossless and lossy compression-entropy encoding –source encoding- text compression –static Huffman coding dynamic Huffman coding –arithmetic coding –Lempel Ziv-Welsh Compression-image compression

VoIP TECHNOLOGY **9**

Basics of IP transport, VoIP challenges, H.323/ SIP –Network Architecture, Protocols, Call establishment and release, VoIP and SS7, Quality of Service – CODEC Methods-VOIP applicability.

MULTIMEDIA NETWORKING **9**

Multimedia Networking- Applications-Streamed stored and audio-making – Best Effort service protocols for real time interactive Applications-distributing multimedia-beyond best effort service secluding and Policing Mechanisms-Integrated services-Differentiated Services-RSVP.

Total Periods: **45**

Text Books:

1. Fred Halshall, "Multimedia Communication - Applications, Networks, Protocols and Standards", Pearson education, 2007.

2. Tay Vaughan, "Multideai: Making It Work", TMH, 8th Edition, 2007.

References:

1. Kurose and W. Ross, "Computer Networking A Top Down Approach", Pearson education, 3rd Edition, 2005.

2. Marcus Goncalves ―Voice over IP Networks, McGraw Hill,

3. KR. Rao,Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education, 2007

4. R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education, 1st Edition, 1995.

5. Ranjan Parekh, "Principles of Multimedia", TMH, 2006.

		L	T	P	C
191BME17	**VLSI DESIGN**	3	0	0	3

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**

Aim: To study the fundamentals of VLSI design

Course Outcomes: The Students will be able to

CO1: Design &understand the IC Manufacturing Process

CO2: Demonstrate VLSI combinational logic circuits design

CO3: Outlineof VLSI sequential logic circuits design

CO4: Identify the various arithmetic circuits and testing methodologies

CO5: Interpret with the different FPGA architectures

CO6: Analyse the arithmetic building blocks.

MOS TRANSISTOR PRINCIPLES **9**

MOSFET and Current Equations, Clock Distance Modeling. Characteristics of CMOS inverter, Scaling principles and fundamental limits. Propagation Delays, CMOS inverter scaling, Stick diagram, Layout diagrams, Elmore‘s constant. Case study: Study of technology development in MOS.

COMBINATIONAL LOGICCIRCUITS **9**

Static CMOS logic Design, Design techniques to improve the speed, power dissipation of CMOS logic, low power circuit techniques, Ratioed logic .Pass transistor Logic, Transmission CPL, DCVSL, Dynamic CMOS logic, Domino logic.

SEQUENTIAL LOGIC CIRCUITS **9**

Static and Dynamic Latches and Registers, Timing Issues, Pipelines, Memory Architectures

ARITHMETIC BUILDING BLOCKS **9**

Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters. Case study: Analysis of area, power and delay for 16 bit adder and 8 bit multiplier.

IMPLEMENTATION STRATEGIES **9**

Full Custom and Semicustom Design, Standard Cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures. Demo: Complete ASIC flow using Backend tool and fabrication flow Overall case study: Development of IC in commercial aspects (design, testing and fab cost)

Total Periods: **45**

Text Books:

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, “Digital Integrated circuits: A design perspective”. Second Edition, Prentice Hall of India, 2003.

References:

1. N.Weste, K.Eshraghian, “Principles of CMOS VLSI DESIGN”, A system Perspective, Addision Wesley, 2nd Edition, 2004.
2. A.Pucknell, Kamran Eshraghian, “BASIC VLSI DESIGN”, Prentice Hall of India, 3rd Edition, 2007.
3. M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 1997.
4. R.Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India, 2005.

191BME18	**HUMAN RIGHTS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Programme: B.E. Biomedical Engineering **Sem:** **Category:** **ESC**

Aim: To sensitize the Engineering students to various aspects of Human Rights.

Course Outcomes: The Students will be able to

CO1: Classify the rights of natural and legal and moral rights

CO2: Importance of UN laws and agencies.

CO3: Acquire the basic knowledge of human rights.

CO4: Know the concept of human rights in India.

CO5: Evolution of the concept of Human Rights Magana carta

CO6: Implementation national and state human rights commission.

UNIT I **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO‘s, Media, Educational Institutions, Social Movements

Total Periods: **45**

Text Books:

References:

1. Kapoor S.K., ―Human Rights under International law and Indian Laws‖, Central Law Agency, Allahabad, 2014.

2. Chandra U., ―Human Rights‖, Allahabad Law Agency, Allahabad, 2014.

3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi

191BME19 **VIRTUAL REALITY AND AUGMENTED REALITY** **L T P C 3 0 0 3**

Programme: B.E. Biomedical Engineering **Sem: 3 Category: ESC**

Aim: To study the virtual reality, augmented reality and using them to build Biomedical engineering applications

Course Outcomes: The Students will be able to

CO1: Analyse & Design a system or process to meet given specifications with realistic engineering constraints.

CO2: Identify problem statements and function as a member of an engineering design team.

CO3: Utilize technical resources

CO4: Propose technical documents and give technical oral presentations related to design mini project results.

CO5: Demonstrate the relevance of this course to the existing technology through demonstrations, case studies and applications with a futuristic vision along with socio-economic impact and issues

CO6: Explain the intricacies of these platform to develop PDA applications with better optimality.

INTRODUCTION **9**

The three I‘s of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.

VR DEVELOPMENT PROCESS **9**

Geometric modelling - kinematics modelling- physical modelling - behaviour modelling - model Management

CONTENT CREATION CONSIDERATIONS FOR VR **9**

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment

VR ON THE WEB & VR ON THE MOBILE **10**

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)-frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics .

APPLICATIONS **8**

Medical applications-military applications-robotics applications- Advanced Real time Tracking-other applications- games, movies, simulations, therapy

Total Periods: **45**

Text Books:

1. C. Burdea & Philippe Coiffet, ―Virtual Reality Technology‖, Second Edition, Gregory, John Wiley & Sons, Inc.,2008
2. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA.

References:

1. Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg & Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575
2. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability), Steve Aukstakalnis, Addison-Wesley Professional; 1 edition, 2016.
3. The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything, Robert Scoble & Shel Israel, Patrick Brewster Press; 1 edition, 2016.
4. Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, Tony Parisi, O‘Reilly Media; 1 edition, 2015.

5. Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages, Tony Parisi, O'Reilly Media; 1 edition, 2014.
6. Learning Three.js: The JavaScript 3D Library for WebGL - Second Edition, Jos Dirksen, Packt Publishing - ebooks Account; 2nd Revised ed. Edition 2015.

AUDIT COURSES

191AC01	ENGLISH FOR RESEARCH PAPER WRITING	L-T-P	C
		2-0-0	0

Programme: M.E.(Applied Electronics) **Sem:** **Category:** **AC**

AIM: To learn the skills required for Research paper writing

Course Objectives:

Students will be able to:

CO1: Understand that how to improve your writing skills and level of readability

CO2: Learn about what to write in each section

CO3: Understand the skills needed when writing a Title

CO4: Ensure the good quality of paper at very first-time submission

CO5: Examine the writing skills

CO6: Verity the manuscript for first time submission.

INTRODUCTION

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Conciseand Removing Redundancy, Avoiding Ambiguity and Vagueness.

CLARIFICATION

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

LTERATURE SURVEY

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

ESSENTIAL SKILLS

Key skills are needed when writing a Title, key skills are neededwhen writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

VERIFICATION

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Lecture: 24 Tutorial:0 Total Periods:24

References

1. Goldbort R “Writing for Science”, Yale University Press ,2006.
2. Day R , “How to Write and Publish a Scientific Paper” , Cambridge University Press, 2006.
3. Highman N “Handbook of Writing for the Mathematical Sciences” , SIAM. Highman’s book ,1998.
4. Adrian Wallwork , “English for Writing Research Papers”, Springer New York Dordrecht Heidelberg London, 2011.

191AC02	DISASTER MANAGEMENT	L-T-P C 2-0-0 0

Programme: M.E.(Applied Electronics) **Sem:** **Category:** **AC**

AIM: To through knowledge, experience and research build capacities that will reduce disaster risks and contribute to better and more targeted public health based relief following disasters.

Course Objectives:

Students will be able to:

CO1: learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO2: critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO3: develop an understanding of standards of humanitarian response and

CO4: Develop practical relevance in specific types of disasters and conflict situations.

CO5: critically understand the strengths and weaknesses of disaster management approaches,planning and programming in different countries, particularly their home country or the countriesthey work in.

CO6: Explain more about disaster mitigation.

INTRODUCTION

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

REPERCUSSIONS OF DISASTERS AND HAZARDS

Economic Damage, Loss of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines,Landslides And Avalanches, Manmade disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And
Conflicts.

DISASTER PRONE AREAS IN INDIA

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

DISASTER PREPAREDNESS AND MANAGEMENT

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

RISK ASSESSMENT

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Disaster Mitigation

Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Lecture: 24 Tutorial:0 Total Periods:24

References

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies " New Royal book Company, 2014.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi, 2001.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi,2009.

191AC03	SANSKRIT FOR TECHNICAL KNOWLEDGE	L-T-P	C
		2-0-0	0

Programme: M.E.(Applied Electronics) **Sem:** **Category:** **AC**

AIM: To Learn Sanskrit through Technical Education

Course Outcomes:

CO1: Understanding basic Sanskrit language

CO2 Get a working knowledge in illustrious Sanskrit, the scientific language in the world

CO3: Learn of Sanskrit to improve brain functioning

CO4: Develop the logic in mathematics, science & other subjects enhancing the memory power..

CO5: Ancient Sanskrit literature about science & technology can be understood

CO6: Being a logical language will help to develop logic in students

UNIT 1

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

UNIT 2

Order, Introduction of roots, Technical information about Sanskrit Literature

UNIT 3

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Lecture: 24 Tutorial:0 Total Periods:24

References

1. Dr.Vishwas "Abhyaspustakam" Samskrita-Bharti Publication, New Delhi,2012.
2. Prathama Deeksha-Vempati Kutumbshastri "Teach Yourself Sanskrit", Rashtriya Sanskrit Sansthanam, New Delhi Publication,2012.
3. Suresh Soni "India's Glorious Scientific Tradition", Ocean books (P) Ltd., New Delhi,2009.

191AC04	VALUE EDUCATION	L-T-P	C
		2-0-0	0

Programme: M.E.(Applied Electronics) **Sem:** **Category:** **AC**

AIM: To Understand value of education and self- development

Course Outcomes:

Students will be able to

CO1: Knowledge of self-development

CO2: Learn the importance of Human values

CO3: Develop the overall personality

CO4: Identify moral and ethics of value Education

CO5: Avoid fault thinking

CO6: Know about the role of human values and equality

MORALS AND ETHICS

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation. Standards and principles, Value judgments.

CULTIVATION OF VALUES

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature , Discipline.

PERSONALITY AND BEHAVIOR DEVELOPMENT

Personality and Behavior Development - Soul and Scientific attitude, Positive Thinking, Integrity and discipline-Punctuality, Love and Kindness-Avoid fault Thinking-Free from anger, Dignity of labour-Universal brotherhood and religious tolerance-True friendship-Happiness Vs suffering, love for truth-Aware of self-destructive habits- Association and Cooperation-Doing best for saving nature.

SCIENCE OF REINCARNATION-

Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation- Equality, Nonviolence ,Humility, Role of Women- All religions and same message,- Mind your Mind, Self-control -Honesty, Studying effectively

Lecture: 24 Tutorial:0 Total Periods:24

Reference

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi,1998.

191AC05	CONSTITUTION OF INDIA	L-T-P	C
		2-0-0	0

Programme: M.E.(Applied Electronics) **Sem:** **Category:** **AC**

AIM: Understand the premises informing the twin themes of liberty and freedom from a civil rightsperspective.

COURSE OUTCOMES:

Students will be able to:

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2: Discuss the intellectual origins of the framework of argument

CO3: Inform the conceptualization of social reforms leading to revolution in India.

CO4: Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO5: Discuss the passage of the Hindu Code Bill of 1956.

CO6: Understand the role of Election commission

HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History ,Drafting Committee, (Composition & Working)

PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES

Fundamental Rights:Right to Equality, Right to Freedom,Right against Exploitation, Right to Freedom of Religion Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

LOCAL ADMINISTRATION

District's Administration head: Role and Importance,Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation,Pachayati raj: Introduction, PRI: Zila Pachayat,Elected officials and their roles, CEO Zila Pachayat: Position and role.Block level: Organizational Hierarchy (Different departments),Village level: Role of Elected and Appointed officials, Importance of grass root democracy

ELECTION COMMISSION:

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning,Institute and Bodies for the welfare of SC/ST/OBC and women.

Lecture: 24 Tutorial:0 Total Periods:24

References

1. The Constitution of India, 1950 (Bare Act), Government Publication.

2. Dr. S. N. Busi, Dr. B. R. Ambedkar "framing of Indian Constitution", 1st Edition, 2015.
3. M. P. Jain, "Indian Constitution Law" , 7thEdn., Lexis Nexis, 2014.
4. D.D. Basu, "Introduction to the Constitution of India" , Lexis Nexis, 2015.

191AC06	**PEDAGOGY STUDIES**	**L-T-P**	**C**
		2-0-0	**0**

Programme: M.E.(Applied Electronics) **Sem:** **Category:** **AC**

AIM: To review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers

Course Outcomes:

Students will be able to

CO1: Create a connection between teaching and learning, between professors and students
CO2: Take much of the guessing out of the student's attempt to learn
CO3: Enable them to truly master the content of the course
CO4: Analyze different teaching approaches from teaching students to memorize.
CO5: describe the measurable skills, abilities, knowledge or values
CO6: Demonstrate as a result of a completing a course

INTRODUCTION AND METHODOLOGY

Aims and rationale, Policy background, Conceptual framework andterminology**,** Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions**,** Overview of methodology and Searching.

THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

PEDAGOGICAL PRACTICES

Evidence on the effectiveness of pedagogical practices,Methodology for the in depth stage: quality assessment of included studies, How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change, Strength and nature of the body of evidence for effective pedagogical Practices,Pedagogic theory and pedagogical approaches,Teachers' attitudes and beliefs and Pedagogic strategies.

PROFESSIONAL DEVELOPMENT

Alignment with classroom practices and follow-up support,Peer support,Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

RESEARCH GAPS AND FUTURE DIRECTIONS

Research design,Contexts**,**Pedagogy**,** Teacher education**,**Curriculum and assessment**,**Dissemination and research impact.

Lecture: 24 Tutorial:0 Total Periods:24

References

1. Ackers J, Hardman F "Classroom interaction in Kenyan primary schools", Compare, 31 (2): 245-261, 2001.
2. Agrawal M "curricular reform in schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361-379,2004.
3. Akyeampong K , Teacher training in Ghana - does it count? Multi-site teacher education research",2003.project (MUSTER) country report 1. London: DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J " Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?" International Journal Educational Development, 33 (3): 272–282,2013.

191AC07	STRESS MANAGEMENT BY YOGA	L-T-P	C
		2-0-0	0

Programme: M.E.(Applied Electronics) **Sem:** **Category:** **AC**

AIM: To achieve overall health of body and mind

Course Objectives: To Develop healthy mind in a healthy body thus improving social health also Improve efficiency

Course Outcomes:

Students will be able to:

CO1: Develop healthy mind in a healthy body thus improving social health
CO2: Classify Yoga Ashtanga
CO3: Learn Do`s and Don't's in life
CO4: Differentiate between Yam and Niyam
CO5: Regularize of breathing techniques
CO6: Implement various yog poses and their benefits for mind and body

UNIT 1

Definitions of Eight parts of yog. (Ashtanga)

UNIT 2

Yam and Niyam.
Do`s and Don't's in life.
i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT 3

Asan and Pranayam
i) Various yog poses and their benefits for mind & body
ii)Regularization of breathing techniques and its effects-Types of pranayam

Lecture: 24 Tutorial: 0 Total Periods:24

References

1. Janardan Swami Yogabhyasi Mandal "Yogic Asanas for Group Tarining-Part-I" , Nagpur , 2014.
2. "Rajayoga or conquering the Internal Nature" Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

191AC08	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L-T-P	C
		2-0-0	0

Programme: M.E.(Applied Electronics) **Sem:** **Category:** **AC**

AIM: To become a person with stable mind, pleasing personality and determination

Course Outcomes:

Students will be able to

CO1: Study of Shrimad-Bhagwad-Geeta

CO2: Develop personality and achieve the highest goal in life.

CO3: Lead the nation and mankind to peace and prosperity.

CO4: Study of Neetishatakam for developing versatile personality

CO5: Learn Do`s and Don't's in life

CO6: Approach day to day work and duties

UNIT 1

Neetisatakam-Holistic development of personality,Verses- 19,20,21,22 (wisdom), Verses- 29,31,32 (pride & heroism),Verses- 26,28,63,65 (virtue), Verses- 52,53,59 (dont's), Verses- 71,73,75,78 (do's)

UNIT 2

Approach to day to day work and duties, Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17,23, 35, Chapter 18-Verses 45, 46, 48.

UNIT 3

Statements of basic knowledge, Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68, Chapter 12 -Verses 13, 14, 15, 16,17, 18,Personality of Role model, Shrimad Bhagwad Geeta:Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39,Chapter18 – Verses 37,38,63

Lecture: 24 Tutorial:0 Total Periods:24

References

1. Swami Swarupananda Advaita Ashram "Srimad Bhagavad Gita" by (Publication Department), Kolkata
2. P.Gopinath, Rashtriya Sanskrit Sansthanam "Bhartrihari's Three Satakam (Niti-sringar-vairagya)" , New Delhi.