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# SCHOOL OF BIO AND CHEMICAL ENGINEERING

# DEPARTMENT OF BIOMEDICAL ENGINEERING

# **B.Tech. Biomedical Engineering**

# **CURRICULUM and SYLLABUS**

(CBCS)

(Regulation-2018)

**Revision** 1

	<b>Department Mission</b>
Department Vision	To produce world class biomedical engineers
To be a globally recognized Centre of	who are Technically Competent, Socially
Evention in the field of Diamadical	Committed Technocrats and Administrators by
Excellence in the relia of Biomedical	imparting inter disciplinary education and
Engineering for the advancement of numan	research for enhancing
nealth.	the quality of life through improved health to
	serve humanity.

# **Program Educational Objectives (B.Tech – Biomedical Engineering)**

PEO 1	Demonstrate their professional skills and technical competence into actions to solve wide range
	of challenging problems in biomedical engineering and related fields.
PEO 2	Effectively communicate in multidisciplinary team to understand, analyze, design and develop
	the products as Biomedical Engineers for the advancement of human health.
PEO 3	Employ excellence, leadership, entrepreneurship, social, professional and ethical responsibility
	in their chosen fields of Biomedical Engineering.
PEO 4	Engage in expanding their knowledge in professional practice as biomedical engineers and/or
	biomedical scientists throughout their career.

# Program Outcome(s):

# Graduates will be able to

PO 1	Apply knowledge of Mathematics, Sciences and Biomedical Engineering fundamentals to solve complex engineering problems.
PO 2	Identify, formulate, analyze and solve problems associated with human health monitoring.
PO 3	Design medical equipment, assist devices, implants, etc., to meet the specified needs within realistic constraints of economic, health and safety, cultural, societal, ethical and environmental considerations.
PO 4	Conduct investigations using relevant research methodology including literature review, design of experiments, analysis and interpretation of data to provide valid conclusions.
PO 5	Utilize the techniques, skills, and modern engineering tools necessary to meet the requirements of the hospital industry.
PO 6	Evaluate societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the biomedical solutions.
PO 7	Demonstrate the impact of Biomedical Engineering solutions on environment and the need for sustainable development.
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PO 9	Communicate effectively on engineering activities with Engineers, Medical Professionals and the community through discussions, reports and presentations.
PO 10	Work as an individual or as a team member for the productive execution of responsibilities.
PO 11	An ability to demonstrate knowledge and understanding Biomedical engineering and hospital management principles and apply these as an Entrepreneur, to manage projects and to work in multidisciplinary environments.
PO 12	Empathize the impact of Biomedical Engineering on society and demonstrateawareness of contemporary issues through independent and life-long learning.

# DEPARTMENT OF BIOMEDICAL ENGINEERING 2018 REGULATION CURICULLUM

S.No	No Category					
Ι	I Basic science and mathematics					
	Humanities and social science	3				
II	Soft skills	3	12			
	Humanities Elective	6				
III	Basic Engineering					
	Program core		61			
IV	a) Core Courses	48				
1 V	b) Community Service Project	3				
	c) Project Work	10				
V	Elective courses		36			
	a) Major Elective	18				
	b) Open elective	18				
VI	VI Internship/ Industry Training					
Total C	redits		160			

### **SCHEME OF INSTRUCTION**

# **I. Basic Science and Mathematics**

S.No	Course Code	Course Name	Course Type	L	Т	Р	С
1	PHY18R175	Optics, Electromagnetism and Quantum mechanics	IC	3	1	2	5
2	CHY18R171	Chemistry	IC	3	1	2	5
3	MAT18R101	Calculus and Linear Algebra	Т	3	1	0	4
4	MAT18R102	Multiple Integration, Ordinary Differential Equations and Complex Variable	Т	3	1	0	4
5	MAT18R201	Biostatistics	Т	3	1	0	4

6	BIT18R101	Biology for Engineers	Т	3	0	0	3
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# II. Humanities and Social Science courses:-

S.NO	Course Code	Course Name	Course Type	L	Т	Р	С
1	HSS18R151	English forTechnical Communication	TP	2	0	2	3
1	HSS18R101	Soft Skills – I	Т	3	0	0	1
2	HSS18R102	Soft Skills – II	Т	3	0	0	1
3	HSS18R201	Soft Skills – III	Т	3	0	0	1

# III - <u>BASIC ENGINEERING</u>

S.No	Course Code	Course Name	Course Type	L	Т	Р	С
1	EEE18R171	Basic Electrical and Electronics Engineering	IC	3	1	2	5
2	MEC18R151	Engineering Graphics and Design	TP	3	0	2	3
3	MEC18R211	Engineering Mechanics	Т	3	1	0	4
4	CSE18R171	Programming for Problem Solving	IC	3	1	2	5
5	MEC18R152	Engineering Practice	TP	3	0	2	3
6	BME18R101	Cell Biology and Genetics	Т	3	1	0	4
TOTAL							

# IV - PROGRAM CORE

# a) CORE COURSES

Code No	Course	Туре	L	Т	Р	С	Pre requisite			
THEORY COURSES(T)										
BME18R201	Human Anatomy and Physiology	Т	3	0	0	3	-			
BME18R202	Clinical Biochemistry	Т	3	0	0	3	-			
BME18R301	Diagnostic and Therapeutic Equipment	Т	3	0	0	3	BME18R252			
BME18R401	Biomedical Image Processing and Analysis	Т	3	0	0	3	BME18R371			
	THEORY WITH PRACTI	CE(TP)	)							
BME18R251	Biocontrol Systems	ТР	3	0	1	3.5	-			
BME18R252	Biomedical Instrumentation	ТР	3	0	1	3.5	EEE18R171			
BME18R351	Biomechanics	ТР	3	0	1	3.5	BME18R201			
BME18R352	Pathology and Microbiology	ТР	3	0	1	3.5	-			
INTEGRATED THEORY WITH PRACTICALS(IC)										
BME18R271	Analog and Digital Electronics	IC	3	0	2	4	-			
BME18R272	Biosensors and Transducers	IC	3	0	2	4	BME18R271			
EEE18R371	Microprocessor and Microcontroller	IC	3	0	2	4	-			
BME18R371	Biomedical Signal Processing	IC	3	0	2	4	-			
	LABORATORY COURS	SES(L)								
Code No	Course	Туре	L	Т	Р	C	Co requisite			
BME18D281	Biochemistry and Human Physiology	т	0	0	3	2	BME18R201,			
DIVIETORZOI	Laboratory	L	U	0	, 5	2	BME18R202			
BME18D381	Biomedical Instrumentation and	T	0	0	3	2	BME18P301			
DIVIE10K301	Equipments Laboratory	L	0	U	5	2	DWIE10K301			
BME18R481	Biomedical Image Processing and Analysis	L	0	0	3	2	BME18R401			
TOTAL CREDITS FOR PROGRAM CORE - 48										

### **b) COMMUNITY SERVICE PROJECT**

Code No	Course	L	Т	Р	С
BME18R399	Community Service Project	0	0	2	3

# c) PROJECT WORK

Code No	Course	L	Т	Р	С
BME18R499	Project Work	0	0	0	10

# **V ELECTIVE COURSES**

# a.) Professional Electives

MAJOR ELECTIVES									
Code No	Course	Туре	L	Т	Р	С	Pre-requisite		
BME18R203	Medical Physics	Т	3	0	0	3	-		
BME18R204	Analog and Digital Communication	Т	3	0	0	3	-		
BME18R205	Biomaterials and Artificial Organs	Т	3	0	0	3	-		
BME18R206	Hospital Management	Т	3	0	0	3	-		
BME18R302	Radiological imaging systems	Т	3	0	0	3	BME18R252		
BME18R303	Medical Optics and lasers	Т	3	0	0	3	-		
BME18R304	Computers in Medicine	Т	3	0	0	3	-		
BME18R305	Design of Biomedical Instruments	Т	3	0	0	3	BME18R252		
BME18R306	Telemedicine	Т	3	0	0	3	-		
BME18R307	Virtual Reality	Т	3	0	0	3	BME18R351		
BME18R308	Biometric Systems	Т	3	0	0	3	BME18R272		
BME18R309	Neural Network	Т	3	0	0	3	-		
BME18R310	Clinical Engineering	Т	3	0	0	3	-		
BME18R311	Biofluids and Dynamics	Т	3	0	0	3	BME18R351		
BME18R312	Embedded Systems in medicine	Т	3	0	0	3	-		
BME18R 313	Mechanics of Biological systems	Т	3	0	0	3	BME18R351		
BME18R402	Human Assist Devices	Т	3	0	0	3	BME18R201		
BME18R403	Rehabilitation Engineering	Т	3	0	0	3	BME18R351		
BME18R404	Modeling of Physiological Systems	Т	3	0	0	3	BME18R251		
BME18R 405	Neural Engineering	Т	3	0	0	3	-		
BME18R406	BioMEMS	Т	3	0	0	3	-		
BME18R407	Tissue Engineering	Т	3	0	0	3	BME18R101		
BME18R408	Nanotechnology in Medicine	Т	3	0	0	3	-		
BME18R409	Advanced Digital Signal Processing	Т	3	0	0	3	BME18R371		

# **b.)** Open Electives

Code No	Course	Туре	L	Т	Р	С
BME18R207	Medical Optics and lasers	Т	3	0	0	3
BME18R314	Computers in Medicine	Т	3	0	0	3
BME18R315	Biomedical Instrumentation	Т	3	0	0	3
BME18R316	Rehabilitation Engineering	Т	3	0	0	3
BME18R317	Telemedicine	Т	3	0	0	3
BME18R410	Tissue Engineering	Т	3	0	0	3

BME18R411	Wearable systems	Т	3	0	0	3
BME18R412	Nanotechnology in Medicine	Т	3	0	0	3
BME18R413	Biometric Systems	Т	3	0	0	3
BME18R414	Biomedical Waste Management	Т	3	0	0	3
BME18R415	Bioethics, IPR and Standards	Т	3	0	0	3
PHY18R301	Photonics and Optoelectronic Devices	Т	3	0	0	3

#### c.) Humanities Electives

S.No	<b>Course Code</b>	Course Name	Туре	L	Т	Р	С
1.	HSS18R001	Management Concepts and Techniques	Т	3	0	0	3
2.	HSS18R002	Marketing Management	Т	3	0	0	3
3.	HSS18R003	Organizational Psychology	Т	3	0	0	3
4.	HSS18R004	Project Management	Т	3	0	0	3
5.	HSS18R005	Stress Management and Coping Strategies	Т	3	0	0	3
6.	HSS18R006	Engineering Economics	Т	3	0	0	3
		Human Resource Management					
7.	HSS18R007	and Labour Law	Т	3	0	0	3
8.	HSS18R008	Entrepreneurship Development	Т	3	0	0	3
9.	HSS18R009	Cost Analysis and Control	Т	3	0	0	3
10.	HSS18R010	Product Design and Development	Т	3	0	0	3
11.	HSS18R011	Business Process Reengineering	Т	3	0	0	3
12.	HSS18R012	Political Economy	Т	3	0	0	3
13.	HSS18R013	Professional Ethics	Т	3	0	0	3
14.	HSS18R014	Operations Research	Т	3	0	0	3
15.	HSS18R015	Total Quality Management	Т	3	0	0	3
16.	HSS18R016	Advanced Softskills	Т	3	0	0	3

# VI INTERNSHIP/ INDUSTRY TRAINING

S.No	Course Code	Course Name	Credits
1	BME18R397/	Industry Training/Internship Training	C
1	BME18R398	Industry Training/ Internship Training	2

# **Mandatory Courses**

- 1. EnvironmentalSciences
- 2. IndianConstitution
- 3. Essence of Indian TraditionalKnowledge

# **One Credit course**

S.No	Course Code	Name of the Course	Course Type	L	Т	Р	С	Pre requisite
1.	BMEO001	Electronic Systems for Cancer Diagnosis	Т	3	0	0	1	-
2	BMEX003	Analog and Digital Communication using Graphical Programming	Т	3	0	0	1	-

#### SYLLABUS Regulation 2018

#### **Basic Science and Mathematics**

Subject Code	e Optics, Electromagnetism and Quantum mechanics		L	Т	Р	C
PHY18R175			3	1	2	5
Pre-requisite: Basic Knowledge in Physics Course			Categ	ory: Pi	ogram	core
		Course '	Гуре:	Integr	ated Co	ourse

#### **Course Objectives:**

- To understand the basic concepts of optics, quantum physics and its applications.
- To provide the students a firm understanding of the basics of Electricity, Magnetism and its applications.

#### **Course Outcomes:**

Upon successful completion of this course, students will be able to

**CO1:** Understand the concepts of diffraction and polarization.

**CO2:** Apply the concepts of optics in laser and fiber optics.

**CO3:** Explore the knowledge on electro statistics.

**CO4:** Understand the fundamentals of magnetism.

**CO5:** Apply the knowledge on solving the wave equations

# UNIT I: DIFFRACTION AND POLARISATION

Diffraction: Introduction to interference and example; concept of diffraction, Fraunhofer and Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits; diffraction grating, characteristics of diffraction grating and its applications.

Polarisation: Introduction, polarisation by reflection, polarisation by double refraction, scattering of light, circular and elliptical polarisation, optical activity

### **UNIT II: LASER AND FIBER OPTICS**

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne), solid-state lasers (Neodymium), applications of lasers in science, engineering and medicine. Numerical aperture and Acceptance angle of fibre – Types of optical fibre - Active and passive fibre sensors-Endoscope.

### UNIT III: ELECTROMAGNETISM AND DIELECTRICS

Laws of electrostatics, electric current and the continuity equation, laws of magnetism. Ampere's Faraday's laws. Maxwell's equations. Polarisation, permeability and dielectric constant, polar and non-polar dielectrics, internal fields in a solid, Clausius-Mossotti equation, applications of dielectrics, Dielectric Breakdown – Types and Remedies

### UNIT IV: MAGNETOSTATICS AND MAGNETIC MATERIALS

Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction,

permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.

# **UNIT V: QUANTUM MECHANICS**

Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, verification of matter waves, uncertainty principle, Schrodinger wave equation, particle in a box (1D).

# LIST OF EXPERIMENTS

- 1. To determine the dispersive power of prism using spectrometer and mercury source
- 2. To determine the wavelength of sodium light by Newton's Ring
- 3. To determine the wavelength of sodium light using diffraction grating
- 4. To determine the numeral aperture (NA) of a Optical Fibre.
- 5. To find the wavelength of He-Ne Laser using transmission diffraction grating.
- 6. To determine the refractive index of a prism/ liquid using spectrometer.
- 7. Deflection magnetometer M and BH TAN C position
- 8. To determine the thickness of a material using air wedge method
- 9. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
- 10. Determination of dielectric constant of liquids / Solids
- 11. Determination of Magnetic Susceptibility

# Text Book(s)

- 1. Ghatak, "Optics" Fith edition, Tata McGraw-Hill Inc, 2012.
- 2. N. Subrahmanyam and Brij Lal, "A Text Book of Optics", S. Chand Limited, 2015.
- 3. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009.
- 4. Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011
- 5. Rajagopal K. Engineering Physics. PHI, New Delhi, 2011

# **Reference Books**

- 1. Kailash K. Sharma Optics: Principles and Applications Elsevier, 2006
- 2. William T. Silfvast, Laser Fundamentals, Cambridge University Press, New York, 2nd Edition, 2004
- 3. Gaur R. K, and Gupta S. L, Engineering Physics, Dhanpat Rai & Sons, New Delhi, 7<sup>th</sup> Edition, 1993
- 4. Halliday D, Resnick R and Waler J, Fundamentals of Physics, Wiley and Sons, New York, 6<sup>th</sup> Edition, 2001
- 5. Rajput B.S, Pragati Prakashan, Advanced Quantum Mechanics, Pragati publications, New Market, Begum Bridge, Meerut, 2009.
- 6. Practical Physics S.L. Gupta & V. Kumar (Pragati Prakashan).
- 7. Advanced Practical Physics B.L. Workshop and H.T. Flint (KPH)
- 8. Advanced Practical Physics Vol. I & II Chauhan & Singh (Pragati Prakashan)
- 9. Physics Laboratory Manual, prepared by Department of Physics, Kalasalingam University.

CHY18R171	Chomistry	L	Т	Р	С
	Chemistry	3	1	2	5

# UNIT -I: ATOMIC AND MOLECULAR STRUCTURE

Schrodinger wave equation:Derivation of time independent Schrodinger wave equation, Representation of Schrodinger wave equation in polar coordinates - Radial distribution function graphs of s, p, d and f orbitals. Molecular Orbital Theory:MOT concept, MO diagrams of homonuclear diatomic molecules (hydrogen, nitrogen and oxygen) and hetero-nuclear diatomic molecules (carbon monoxide and nitric oxide). Crystal field theory:CFT concept, weak and strong ligands, energy level diagrams of transition metal ions (Fe<sup>2+</sup>& Fe<sup>3+</sup>) in octahedral and tetrahedral complexes and their magnetic properties. Intermolecular forces - Ionic, dipolar and van der Waals interactions.

### **UNIT-II: PERIODIC PROPERTIES**

Effective nuclear charge - Factors affecting effective nuclear charge: Penetration or shielding of orbitals - Variation of s, p, d and f orbital energies of atoms in the periodic table - Aufbau principle(Building-up principle): Application of Aufbau principle in writing electronic configuration, Deviation from Aufbau principle - Periodicity of properties in a periodic table - Periodic properties: Atomic and ionic sizes, ionization energies, electron affinity and electronegativity - Variation of periodic properties in the periodic table - Hard soft acids and bases: Concept and examples.

# UNIT-III: FREE ENERGY AND CHEMICAL EQUILIBRIA

Thermodynamic functions:Definition and mathematical expression for Work, Energy, Enthalpy, Entropy and Free energy - Nernst equation:Derivation, apply Nernst equation to determine of solubility product, pH (glass electrode). Potentiometric titrations: Acid-Base, Redox and precipitation reaction - Water analysis:Hardness by EDTA method and chloride ion by Argentomentric method - Corrosion: Definition, types (dry & wet) and mechanism. and control of Dry and Wet corrosion.

### **UNIT-IV: ORGANIC REACTIONS**

Nucleophilic substitution reactions: Definition, types and examples of nucleophile, Compare nucleophilicity and basicity of a nuceophile - Types of nucleophilic substitution (case RX and ArX): Mechanism of  $S_N1$ ,  $S_N2$ ,  $S_Ni$  and Benzyne. Electrophilic substitution reactions: Definition, types and examples of electrophile - Electrophilic substitution reactions of hydrocarbons: Halogenation, sulphonation, nitration. Friedel crafts alkylation and acylation reaction. Nucleophilic addition reactions (case aldehydes and ketones):Polarity of C=O bond. General mechanism of nucleophilic addition reactions on aldehydes and ketones: HCN, HOH, ROH and NaHSO<sub>3</sub> addition. Electrophilic addition reactions (case alkenes):General mechanism of electrophilic addition reactions on alkene - Addition of HBr [Markownikoff& Anti-Markownikoff (peroxide effect)] - Addition of alkene (polymerization of ethylene). Elimination reactions: Types of elimination reactions (case alkyl halides): Dehydrohalogenation of alkyl

halides -  $E_1$  and  $E_2$  mechanism - Dehydration of alcohols to alkene and ethers. Greener synthesis of drug molecules (Aspirin and Ibuprofen)

# **UNIT-V: STEREOCHEMISTRY & SPECTROSCOPIC TECHNIQUES**

Stereochemistry - Definition with examples: Geometrical isomers (alkene) and stereoisomers, symmetry, chirality, enantiomers, diastereomers, meso and racemic mixture. Representation of 3D structures: Wedge formula, Fischer projections, Newmann and Sawhorse formula (upto 2 carbons) - Conformational analysis: Ethane, butane and cyclohexane - Configurational analysis: Rules of RS nomenclature and application of RS nomenclature to molecules containing one chiral centre. Electronic spectroscopy:Principle, instrumentation, selection rules and medicinal application of fluorescence spectroscopy. Nuclear magnetic resonance spectroscopy (<sup>1</sup>H-NMR): Principle, instrumentation, chemical shift, coupling constant and application (structural identification of the compound  $C_3H_6O$  from <sup>1</sup>H-NMR data). X-ray diffraction:Principle, instrumentation and applications X-ray diffraction.

# LIST OF EXPERIMENTS (ANY 10):

- 1. Determination of Viscosity by Ostwald Viscometer.
- 2. Determination of surface tension by stalagmometer.
- 3. Adsorption of acetic acid by charcoal.
- 4. Determination of chloride content of water.
- 5. Estimation of hardness of water by EDTA method.
- 6. Determination of the rate constant of a reaction
- 7. Thin layer chromatography.
- 8. Determination of the partition coefficient of a substance between two immiscible liquids
- 9. Determination of Saponification /acid value of oil.
- 10. Preparation of Aspirin
- 11. Potentiometric titration of strong acid vs strong base.
- 12. Potentiometric titration of weak acid vs strong base.
- 13. Determination of cell constant and conductance of solutions.

# TEXT BOOKS

- 1. Engineering Chemistry, 2<sup>nd</sup> Edition, Wiley India (P) Ltd., 2018.
- 2. Stereochemistry of Organic Compounds, Ernest L. Eliel, Samuel H. Wilen Student edition, Wiley India (P) Ltd., 2017.
- 3. University Chemistry, by B. M. Mahan and R.J.Mayers, Pearson Publishers, 11<sup>th</sup> Edition, Noida, 2017.
- 4. Chemistry Laboratory Manual, Department of Chemistry, Kalasalingam University, 2018.

### **REFERENCE BOOKS**

1. Fundamentals of Molecular Spectroscopy, by C. N. Banwell and E.M. McCash, Tata McGraw-Hill Publishers, 4<sup>th</sup> Edition, New Delhi, 2008.

- 2. Physical Chemistry, by P. W. Atkins and J.D. Paula, W H Freeman & Co Publishers, 10<sup>th</sup> Edition, 2014.
- 3. Modern Inorganic Chemistry, R. D. Madan, 4<sup>th</sup> Edition S. Chand & Company Ltd., 2009.
- Organic Chemistry, Paula Y. Bruice, 7<sup>th</sup> Edition, Pearson (Dorling Kindersley India (P) Ltd.) 2014.
- 5. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, M. S. Pathania, 47<sup>th</sup> Edition, Vishal Publishing Co., 2017.
- 6. Spectrometric Identification of Organic Compounds, Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, 8<sup>th</sup> Edition, Wiley India (P) Ltd., 2010.
- 7. Inorganic Chemistry, Peter Atkins, Mark Weller, Fraser Armstrong, Jonathan Rourke, Tina Overton, Michael Hangerman 5<sup>th</sup> Edition, Oxford press, 2015.
- 8. Organic Chemistry, Volume 1, I. L. Finar, 6<sup>th</sup> Edition, Pearson (Thomson press India (P) Ltd.) 2014.

MAT18D101	CALCULUS AND LINEAR ALCERRA	L	Τ	Р	С
WIAIIOKIUI	CALCOLUS AND LINEAR ALGEDRA	3	1	0	4

#### **Course Objective:**

To enable the students to acquire knowledge and skills in basic components of calculus, to handle the situations involving multivariable calculus, and to diagonalize a symmetric matrix using eigenvalues and eigenvectors.

#### **Course Outcomes:**

Upon successful completion of this course, students will be able to

1. Know the fundamental theorems such as Rolle's theorem, Mean value theorem, Taylor's theorem and its applications.

2. Understand the basic concepts of limit, continuity, derivative, partial derivative and total derivative and its applications.

3. Solve the real world problems using differentiation and integration.

4. Understand the concepts of sequence, convergent of sequences, series and testing of convergent of series using different methods.

5. Find the solution of simultaneous linear equations using matrices and to find the eigen values and eigen vectors of a matrix, Cayley-Hamilon theorem and orthogonal transformations.

### **UNIT 1: CALCULUS**

Rolle's Theorem- Mean value theorems - Taylor's and Maclaurin theorems with remainders - indeterminate forms and L'Hospital's rule - Maxima and minima.

# UNIT 2: MULTIVARIABLE CALCULUS (DIFFERENTIATION)

Limit, continuity and partial derivatives - directional derivatives - total derivative - Maxima, minima and saddle points - Method of Lagrange multipliers.

**UNIT 3: CALCULUS (APPLICATIONS)** 

Curvature (Cartesian coordinates) - Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

### **UNIT 4: SEQUENCES AND SERIES**

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions;

#### **UNIT 5: MATRICES**

System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Cayley-Hamilton Theorem - Diagonalization of matrices - Orthogonal transformation- Reduction of Quadratic form to Canonical form.

#### TEXT BOOKS

1. Grewal, B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2015.

### **REFERENCE BOOKS**

- 1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited,
- 2. Singapore , 10<sup>th</sup> Edn., 2001.
- 3. Ramana B. V., Engineering Mathematics, Tata McGraw-Hill Publishing Company Limited,
- 4. New Delhi, Edition 2005.
- 5. Veerarajan, T., Engineering Mathematics (For First Year), Tata McGraw-Hill publishing
- 6. company Limited, 2008.

MAT18R102	Multiple	Integration,	Ordinary	Differential	Equations	L	Т	Р	С
	Complex '	Variable				3	1	0	4

#### **Course Objective:**

To enable the students to understand the concepts of multiple integrations, their applications, and to handle analytic functions on complex plane and perform complex integration.

#### **Course Outcomes:**

Upon successful completion of this course, students will be able to

- 1. Understand the concepts of double and triple integral and its applications.
- 2. Know about the applications of double and triple integral in vector calculus.
- 3. Know the methods of solving differential equations of first and second orders.
- 4. Understand the concepts of analytic functions, conformal mappings and bilinear transformations.

5. Understand the concepts of singularity, residues and evaluation of certain improper integrals.

### UNIT 1: MULTIVARIABLE CALCULUS (INTEGRATION)

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volume; Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

#### **UNIT 2: INTEGRAL THEOREMS**

Gradient, curl and divergence. Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

#### **UNIT 3: ORDINARY DIFFERENTIAL EQUATIONS**

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equations.

#### **UNIT 4: COMPLEX VARIABLE – DIFFERENTIATION**

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

#### **UNIT 5: COMPLEX VARIABLE – INTEGRATION**

Contour integrals, Cauchy Integral formula (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals (Integration around small semicircles and rectangular contours).

### TEXT BOOKS

1. Grewal, B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2015.

### **REFERENCE BOOKS**

- Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore, 10<sup>th</sup> Edn., 2001.
- 2. Ramana B. V., Engineering Mathematics, Tata McGraw-Hill Publishing Company Limited, New Delhi, Edition 2005.
- 3. Veerarajan, T., Engineering Mathematics (For First Year), Tata McGraw-Hill publishing company Limited, 2008.

MAT18R201	<b>Bio-Statistics</b>	L	Т	Р	С
	Div Statistics	3	1	0	4

#### **Course Objective:**

To enable the students to understand the concepts of probability and statistics and to solve real world problems using statistical tools.

#### **Course Outcomes:**

Upon successful completion of this course, students will be able to

- 1. Know the methods of finding averages, deviations, moments and skewness and kurtosis.
- 2. Understand the concepts of probability and to know about the discrete and continuous distributions.
- 3. Understand the concepts of correlation and regression and its applications.
- 4. Fit the curve of first and second degree equations by least square method and know the method

of analysis of variance.

5. Study about the testing of hypothesis of small and large samples.

# **UNIT 1:STATISTICAL AVERAGES**

Introduction – Diagrammatic representation of data – Graphic representation of data – Measures of central tendency: Arithmetic mean, Geometric mean, Harmonic mean, Median and Mode – Measures of dispersion: Range, Mean deviation and Standard deviation – Moments, Skewness and Kurtosis.

#### **UNIT 2:PROBABILITY**

Introduction – Probability – Theorems on probability - Addition Rule – Multiplication rule – Probability distributions: Binomial, Poisson and Normal distributions.

#### **UNIT 3:CORRELATION AND REGRESSION**

Introduction – Types of correlation – coefficient of correlation – Rank correlation – Regression – Difference between correlation and regression – Regression equations – Applications of regression **UNIT 4: FITTING OF CURVES AND ANALYSIS OF VARIANCE** 

# Principles of least square techniques – Fitting a straight line – Fitting a second degree parabola –

Fitting a curve of the types  $y = bx^a$ ,  $y = ae^{bx}$ ,  $y = ka^{bx}$  - Analysis of variance (ANOVA) – one criterion and two criterion of classification.

### **UNIT 5:TESTING OF HYPOTHESES**

Test for single mean- mean difference – proportion – difference of proportions- small sample tests: based on t and F distributions – chi-square test for population variance – Chi-square test to goodness of fit.

# TEXT BOOKS

- 1. Khan and Khanum, Fundamentals of Biostatistics, Ukaaz Publications, Reprint 2004.
- 2. Arumugam and Issac, Statistics, New Gamma Publishers, July 2013.

BIT18P101	<b>BIOLOGY FOR ENGINEERS</b>	L	Τ	P	С
DITIONIUI		3	0	0	3

#### **Course outcomes**

CO1:Describe the fundamentals of cell structure and cell cycle

**CO2:**Understand the classification and functions of biomolecules

**CO3:**Elaborate the basic cellular mechanisms such as replication, transcription and translation

**CO4:** Describe the underlying concepts of infection and immunity.

CO5:Explain various applications of biology

### **Unit I: INTRODUCTION**

Fundamental difference between science and engineering- comparison between eye and camera, Bird flying and aircraft; major discoveries in biology- ; Classification based on: Cellularity-Unicellular and Multicellular; Ultra structure - prokaryotes and eukaryotes; three major kingdoms of life; Cell structure, intracellular organelles and their functions, comparison of plant and animal cells- Overview of Cell cycle and cell division.

#### 9 hours

#### **Unit II: BIOMOLECULES**

Chemistry of biomolecules: Carbohydrates, Lipids, Proteins; classification of amino acids; classification of proteins based on structure and functions; Nucleic acids -types, structure and function of DNA and RNA

#### **Unit III: GENES TO PROTEINS**

Gene, Genome and chromosome; Central dogma of molecular biology; Classical experiments of DNA: Griffith and, Avery, McCarty and MacLeod, Meselson and Stahl - DNA replication, Transcription and Translation

#### **Unit IV:MICROBIOLOGY**

Microscopy; Microbes as infectious agents - malaria, tuberculosis, typhoid, polio, dengue, AIDS;; cultivation of bacteria. Immunity - innate and acquired immunity - organs and cells of the immune system - classification of antibodies - types of T cells - transplantation, autoimmunity overview

#### **Unit V: APPLICATIONS OF BIOLOGY**

Healthcare-antibiotics, vaccines, monoclonal antibodies, insulin and interferons; Beneficial bacteria - probiotic bacteria, nitrogen fixing bacteria, fermentation and fermented foods and products Environmental - waste water treatment, bioremediation; Biomaterials and biopolymers for medical and environmental applications; Biosensors

#### TEXT BOOKS

- De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology- Lippincott Williams & Wilkins- Philadelphia- USA- 8<sup>th</sup> Edition- 2010.
- 2. Voet, D., Voet, G., Biochemistry John Wiley and Sons, Singapore 3<sup>rd</sup> Edition- 2001.
- 3. Pelczar MJ, Chan ECS and Krieg NR Microbiology Tata McGraw Hill, India- 7<sup>th</sup> Edition- 2010

#### **REFERENCES**

1. Friefelder. D. -Molecular Biology- McGraw-Hill Companies- New York, USA- 5th Edition- 2013.

HSS18R151	English for Technical Communication	L	Т	Р	C
		2	0	2	3
1	UNIT I – VOCABULARY BUILDING				
1.1	The concept of word formation				
1.2	Root words from foreign languages and their use in English				
1.3	Prefixes and suffixes; word derivatives using them				
1.4	Synonyms, Antonyms and standard Abbreviations				
2	UNIT II – BASIC WRITING SKILLS				

#### 9 hours

9 hours

# **9 hours**

#### 9 hours

- 2.1 Sentence structures
- 2.2 Use of phrases and clauses in sentences
- 2.3 Creating Coherence
- 2.4 Techniques for Writing Precisely

# **3** UNIT III – IDENTIFYING COMMON ERRORS IN WRITING

- 3.1 Tenses
- 3.2 Subject verb agreement
- 3.3 Noun Pronoun Agreement
- 3.4 Verbs Transitive, Intransitive
- 3.5 Misplaced Modifiers
- 3.6 Articles
- 3.7 Prepositions
- 3.8 Redundancies and Clichés
- 3.9 Direct, Indirect speech
- 3.10 Infinitives, Gerunds
- 3.11 Comparison of adjectives

### 4 UNIT IV NATURE AND STYLE OF SENSIBLE WRITING

- 4.1 Describing
- 4.2 Defining
- 4.3 Classifying
- 4.4 Providing examples or evidence
- 4.5 Writing introduction or conclusion

### 5 WRITING PRACTICES

- 5.1 Comprehension
- 5.2 Precis writing
- 5.3 Essay writing
- 5.4 Letter writing
- 5.5 Instructions
- 5.6 Paragraph development

### 6 UNIT VI – ORAL COMMUNICATION

- i) Listening comprehension
- ii) Pronunciation, intonation, stress and rhythm
- iii) Common everyday situations: Conversations and dialogues
- iv) Interviews
- v) Formal presentations

			Cre	dits	
EEE18R171	<b>Basic Electrical and Electronics Engineering</b>	L	Т	Р	Total
		3	1	2	5
Due veguicites	Course Category: Basi	c Engine	ering		
Pre-requisite:	Course Type: Integrate	d Course			

#### **Course Objective(s):**

To focus the fundamental ideas of the Electrical and Electronics Engineering by providing wide exposure to the basic concepts of Electrical and Electronics Engineering such as DC Circuits, AC Circuits, electrical machines, measuring instruments, Basic Electronic Devices and various electronic circuits such as rectifiers, amplifiers, oscillators, etc.

#### **Course Outcome(s):**

After completing this course, the student will be able to:

**CO1:** Apply the basic laws of electricity in DC and AC circuits

- co2: Describe the construction and operation of static and rotating electrical machines
- **co3**: Explain the functioning of measuring instruments and Develop the basic domestic wiring circuit.

**CO4**: Describe the constructional features and operation of fundamental electronic devices **CO5**: Explain the characteristics of electronic circuits

CO /						I	90						PSO		
PO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	М	М		М	Μ	L		L	L	L					
CO2	М	Μ		Μ	Μ	L		L	L	L					
CO3	М			Μ	Μ	L		L	L	L					
CO4	Н	М													
CO5	Η	Η	L	Μ	Μ	L	L	L	L	L					

#### Mapping of Course Outcome(s):

**Course Topics:** 

#### **UNIT 1: DC CIRCUITS AND AC CIRCUITS**

Electrical quantities - resistors - inductors - capacitors - Ohm's Law - Kirchhoff's Laws - series and parallel circuits - analysis of DC circuits - mesh, nodal - simple problems- Sinusoidal functions - phasor representation - RMS and Average values - form and peak factors - RLC series circuits - power and power factor-concept of three phase system.

#### **UNIT 2: ELECTRICAL MACHINES**

Construction and principle of operation of DC machines - generator, motor - single phase transformers - alternators - three phase and single phase induction motors.

#### 20

# **12 HOURS**

#### **UNIT 3: MEASUREMENT INSTRUMENTS AND WIRING CIRCUITS12 HOURS**

Moving coil and moving iron instruments - dynamometer type wattmeter - induction type energy meter, Domestic wiring - accessories - types - staircase wiring - fluorescent tube circuits - simple layout –grounding

#### **UNIT 4: ELECTRONIC DEVICES**

Basic concepts of PN junction diodes - Zener diode - bipolar junction transistor - unipolar devices - FET, MOSFET, UJT - Thyristor–SCR and Triac, Photoelectric Devices-Photo diode and Photo transistor

#### **UNIT 5: ELECTRONIC CIRCUITS**

Half wave and full wave rectifier –Transistor as an amplifier –RC- phase shift oscillator - RC integrator and differentiator circuits - diode clampers and clippers - multivibrators - Schmitt trigger

#### Text Book(s)

- 1. V.K. Mehta, "Principles of Electrical Engineering and Electronics", S. Chand & Company Ltd, 2012
- 2. Kothari D P and Nagrath I J, "Basic Electrical Engineering", McGraw Hill, 2009.
- 3. Mithal G K, Electronic Devices & Circuits, Khanna Publications, 1997

#### **Reference**(s)

- 1. T. Thyagarajan, "Fundamentals of Electrical and Electronics Engineering", SciTech publications (Ind.) Pvt. Ltd., 3rd Edition, 2015.
- 2. Muraleedharan K.A, Muthususbramanian R and Salivahanan S, "Basic Electrical, Electronics and Computer Engineering" Tata McGraw Hill,2006.
- 3. Shanthakumar S.R.J, Basic Mechanical Engineering, Third Revised Edition (Reprint 2009), Anuradha Publications, Kumbakonam, 1999.
- 4. Rajput R. K., Basic Mechanical Engineering, Fourth edition, Tata McGraw Hill Publishing Co., New Delhi, 2007.

#### LIST OF EXPERIEMENTS

- 1. Verification of Kirchoff's Laws.
- 2. Verification of AC voltage measurements
- 3. Demonstration of DC Motor
- 4. Demonstration of Transformer
- 5. Demonstration of Induction Motor
- 6. Measurement of Voltage, Current and Power in AC Circuit
- 7. Wiring layout for Staircase
- 8. Wiring layout for Fluorescent lamp
- 9. Conduct a suitable experiment to demonstrate the VI characteristics of characteristics PN diode and Zener Diode
- 10. Design a diode based Half wave and Full wave rectifier

# **12 HOURS**

			Cre					
MEC18R151 ENGINEERING GRAPHICS & DE	ESIGN	L	Т	Р	Total			
Dro roquicito: Nil	Course	e Catego	ry: Basi	c Engine	ering			
	Course Type: Theory with Practical							

#### **Course Objective(s):**

This course aims to introduce the concept of graphic communication, develop the drawing skills for communicating concepts, ideas and designs of engineering products, Demonstrate skills in interpreting, and producing engineering drawings accurately and to give exposure to national standards relating to engineering drawing

#### **Course Outcome(s):**

After completing this course, the student will be able to:

**CO1:** Create the projection of points in all quadrants and straight lines

CO2: Construct the projections of planes and solid objects with refer to reference planes

**CO3:** Illustrate the true shape of truncated solids in both the manual and computerized manner

CO4: Develop surfaces of truncated solids in both the manual and computerized man

**CO5:** Apply orthographic and isometric projections in both the manual and computerized man **Mapping of Course Outcome(s):** 

CO/	PO												PSO		
PO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2		2												
CO2		3										1			
CO3	2		3		3		3					2			
CO4	1	2			3		3					3			
CO5	3		3		3		3					3			

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

#### **Course Topics:**

### **UNIT 1: PROJECTION OF POINTS AND STRAIGHT LINES**

#### 9 HOURS

Importance of graphics – use of drafting instruments – BIS conventions and specifications – size, layout and folding of drawing sheets – lettering dimensioning and scales - Projection of points, located in all quadrants - projection of straight lines located in the first quadrant, determination of true lengths and true inclinations

#### **UNIT 2: PROJECTION OF PLANES AND SOLIDS**

Projection of polygonal surface and circular lamina located in first quadrant inclined to one or both reference planes-Projection of solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method

#### **UNIT 3: SECTION OF SOLIDS**

Section of simple solids like prisms, pyramids, cylinder and cone in vertical position by cutting planes inclined to any one of the reference planes, obtaining true shape of section

#### **UNIT 4: DEVELOPMENT OF SURFACES**

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones

### UNIT 5: ORTHOGRAPHIC AND ISOMETRIC PROJECTION 9 HOURS

Orthographic principles – missing view - free hand sketching in first angle projection from pictorial views. Principles of isometric projection – isometric view and projections of simple solids, truncated prisms, pyramids, cylinders and cones. Introduction to CAD software – menus and tools – drafting platform demonstration

#### **Practical Modules**

- 1. Construction of conic sections using CAD software
- 2. Construction of simple planes using exclusive commands like extend, trim etc.,
- 3. Construction of 3D model solids and sectional views
- 4. Generating 2D orthographic blue prints from 3D part models
- 5. Vectorization of simple building plan and elevation

### Text Book(s)

1. Basant Aggarwal and C. Aggarwal, Engineering Drawing, McGraw-Hill, 2013.

- 2. N.S. Parthasarathy, Vela Murali, Engineering Drawing, Oxford University Press, 2015.
- 3. K. Venugopal, Engineering Drawing + AutoCAD, New Age; Fifth edition, 2011.

### **Reference**(s)

- 1. Shah, M.B., and Rana, B.C., Engineering Drawing, Pearson 2009
- 2. Natarajan, K.V., A Text Book of Engineering Graphics, 21st Edition, Dhanalakshmi Publishers, Chennai, 2012.
- 3. Paul Richard, Jim Fitzgerald., Introduction to AutoCAD 2017: A Modern Perspective, Pearson, 2016.
- 4. Bhatt, N.D., Engineering Drawing, Charotar publishing House, New Delhi, 53trd Edition, 2014.
- 5. Luzadder and Duff, "Fundamentals of Engineering Drawing", Prentice Hall of India Pvt. Ltd., 2009.
- 6. Venugopal, K., Engineering Graphics, New Age International (P) Limited, 2009.

#### 9 HOURS

			Cre	dits			
<b>MEC18R211</b>	ENGINEERING MECHANICS	L	Т	Р	Total		
		3	1	0	4		
<b>Pro roquisito:</b> Nil	Cour	se Cate	gory: Ba	asic Eng	ineering		
rie-iequisite: Mi		Course Type: Theory					

#### **Course Outcome(s):**

After completing this course, the student will be able to:

**CO1**: Explain the vectorial and scalar representation of forces and moments of particles and rigid bodies both in two dimensions and in three dimensions.

CO2: Apply the knowledge of trusses in frames, beams and machine components.

CO3: Contrast the effect of friction on equilibrium.

**CO4**: Illustrate the importance of properties of surfaces and solids.

**CO5**: Demonstrate the dynamic equilibrium equation.

#### Mapping of Course Outcome(s):

CO /						]	90						PSO			
РО	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	3	3	2	1												
CO2	3	2	2	1												
CO3	3	3	2	1												
CO4	3	2	2	1												
CO5	3	1	1	1												

3-StrongCorrelation-2-MediumCorrelation-1-LowCorrelation

### UNIT 1. STATICS OF PARTICLES AND RIGID BODIES (9+3)

Six Fundamental principles and concepts - vector algebra - Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D - System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant - Equations of Equilibrium of Coplanar Systems and Spatial Systems.

Rigid Body equilibrium in 2-D & 3-D - Moment of Forces and its Application - Couples and Resultant of Force System - Equilibrium of System of Forces, Free body diagrams - Equations of Equilibrium of Coplanar Systems and Spatial Systems.

#### UNIT 2. ANALYSIS OF TRUSSES (9+3)

Basic Structural Analysis- Equilibrium in three dimensions - Method of Sections- Method of Joints- How to determine if a member is in tension or compression- Simple Trusses- Zero force members- Beams & types of beams- Frames & Machines.

#### UNIT 3. FRICTION (9+3)

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction - Motion of Bodies, simple contact friction, sliding block, wedge friction, screw jack & differential screw jack, rolling resistance.

#### UNIT 4. PROPERTIES OF SURFACES AND SOLIDS (9+3)

Centroid of simple figures from first principle, centroid of composite sections - Centre of Gravity and its implications - Area moment of inertia - Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections (T section and I section) - Mass moment inertia of circular plate, Cylinder, Cone, Sphere- Principal moment of inertia.

#### UNIT 5. DYNAMICS (9+3)

Review of particle dynamics - Displacements, velocity and acceleration, their relationship -Equations of motions - Rectilinear motion- Plane curvilinear motion - Newton's 2nd law-Impulse, momentum, impact - D'Alembert's principle and its applications in plane motion and connected bodies - Work energy principle and its application in plane motion of connected bodies - Virtual Work and Energy Method - Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies.

#### Text Book(s)

1. Beer, F.P., and Johnson, E.R., Vector Mechanics for Engineers – Statics and Dynamics, McGraw Hill, Tenth Edition in SI units

#### **Reference**(s)

1. Merriam, J.L., Engineering Mechanics, Volume I – Statics, and Volume – II, Dynamics 2/e, Wiley International, Seventh Edition.

2. Irving, H., Shames, Engineering Mechanics, Statics and Dynamics, Prentice Hall of India Ltd., Fourth Edition

CSF18R171	PROGRAMMING FOR PROBLEM SOLVING	L	Т	Р	Credit							
CSEIORI/I	TROOMAINING FOR TRODLEM SOLVING	3	1	2	5							
Due neguisite · N	Course Category : Basic Eng	Course Category : Basic Engineering										
Pre-requisite : IN	<b>Course Type</b> : Integrated	l Cour	se									

#### **Course Objectives:**

To make the students to understand the basic concepts of programming language, rules to be followed while writing a program and how to compile and execute C programs.

#### **Course Outcomes**

**CO1**: Understand the basic programming concepts and syntax of C language

CO2: Develop efficient code using pointers, arrays and dynamic memory allocation

- CO3: techniques
- **CO4**: Create user defined data types and functions to solve given problems.
- **CO5**: Design an efficient algorithm for a given problem
- **CO6 :** Build efficient code to solve the real world problem
- **CO7**: Elucidate the programming constructs of C during interview

#### **CO, PO and PSO Mapping:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	S	S		S					М	М			S	S		
CO 2		S		S		М	М						S	s		
CO 3	S	S			М		S	S	М		М	М			S	
CO 4	S	S	S								S	S	S	М	S	М
CO 5		S		S	S		М						S		S	М
CO 6	S	S		М		S					S	М				S

#### **UNIT 1: INTRODUCTION TO PROGRAMMING**

12 hours

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.), Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/ Pseudocode with examples, From algorithms to programs; source code, variables (with data types) variables and memory, locations, Syntax and Logical Errors in compilation, object and executable code, Arithmetic expressions and precedence, Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

#### **UNIT 2: ARRAYS AND STRINGS**

Introduction - One dimensional and two dimensional arrays – Declaration of arrays – Initializing and Accessing array elements – Strings: One dimensional character arrays - Declaration and String Initialization - String Manipulation - Multidimensional Arrays - Arrays of Strings

#### **UNIT 3: BASIC ALGORITHMS**

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

#### **UNIT 4: FUNCTION**

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion, Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

# 12 hours

12 hours

12 hours

#### **UNIT 5: STRUCTURE, POINTERS & FILE HANDLING** 12 hours

Structures, Defining structures and Array of Structures, Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation), File handling (only if time is available, otherwise should be done as part of the lab)

#### **TEXT BOOKS**

(i) Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill

(ii) E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

#### **REFERENCE BOOKS**

(i) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

#### LIST OF EXPERIMENTS

Tutorial 1: Problem solving using computers:

Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:

Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:

Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:

Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:

Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings

Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:

Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):

Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls

Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation

Lab 11: Pointers and structures

Tutorial 12: File handling:

Lab 12: File operations

			Cre	dits							
MEC18R152	ENGINEERING PRACTICE	L	Т	Р	Total						
		3	0	2	3						
Dro requisitor Nil	Course Category: Basic Engineering										
rie-requisite: Mi	Course Type: Theory with Practical										

#### 15 hours

#### Lectures & videos: Detailed contents

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (**3 lectures**)

- 2. CNC machining, Additive manufacturing (1 lecture)
- 3. Fitting operations & power tools (1 lecture)
- 4. Carpentry (1 lecture)
- 5. Plastic moulding, glass cutting (1 lecture)
- 6. Metal casting (1 lecture)
- 7. Welding (arc welding & gas welding), brazing (1 lecture)

# Suggested Text/Reference Books:

(i) Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.

(ii) Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.

(iii)Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008.

(iv) Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.

(v) Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

# **Course Outcomes**

Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

# (ii) Workshop Practice:

- 1. Machine shop (**10 hours**)
- 2. Fitting shop (8 hours)
- 3. Carpentry (6 hours)
- 4. Welding shop (8 hours (Arc welding 4 hrs + gas welding 4 hrs)
- 5. Casting (8 hours)
- 6. Smithy (6 hours)
- 7. Plastic moulding & Glass Cutting (6 hours)

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

### Laboratory Outcomes

- Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.

• By assembling different components, they will be able to produce small devices of their interest.

<b>BME18D101</b>	CELL BIOLOCY AND CENETICS	L	Т	Р	Credit						
DWILTOKIUI	CELE DIOLOGI AND GENETICS	3	1	0	4						
Pre-requisite: Nil	Course Cate	gory:	Basic	e Eng	ineering						
	Course Type: Theory										

Objective(s): To understand the basic concepts of cell, microscopes and genetics

#### Course Outcome(s)

- **CO1** Distinguish prokaryotic cell from eukaryotic cell and describe the structure and function of different parts of a eukaryotic cell
- CO2 Explain the mitosis and meiosis cell division and the consequences
- CO3 Explain different types of microscopes and their main uses
- CO4 Appreciate the discovery of Mendelian laws
- **CO5** Describe the culture media for cell and tissue culture and the growth of new tissues invitro.

Mapp	Mapping of COs and Pos													
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		
CO1			Н											
CO2							Н	Н						
CO3		М					Н							
CO4														
CO5											Н			

UNIT I - STRUCTURE AND FUNCTION OF CELL ORGANELLES

(9 HOURS)

History of cell - Development of cell theory - General organization of eukaryotic cell - Organization of cell membrane, Cell permeability, Differentiations of the cell membrane - Intercellular communications and Gap junctions, Cytoskeleton and cell motility - Microtubules, microfilaments and intermediate filaments, Endoplasmic reticulum and protein segregation, Golgi complex and cell secretion - Lysosomes, endocytosis, coated vesicles, endosomes and peroxisomes, Mitochondria and Oxidative Phosphorylation, nucleus, ribosomes- nucleolus, chromatin and chromosomes.

#### **UNIT II - CELL CYCLE AND CELL DIVISION**

The cell cycle, Regulation - Role of cyclins and Cdks, Cell cycle check points, General description and different stages of mitosis and meiosis, Functional role of mitotic apparatus, Consequences of meiosis and types of meiosis, difference between mitosis and meiosis.

#### UNIT III - CELL SIGNALING

(9 HOURS)

(9 HOURS)

Signalling molecules and their receptors, functions of cell surface receptors, Pathways of

intracellular signal transduction, Role of Cytoskeleton in signal transduction.

# **UNIT IV - HUMAN GENETICS**

# (9 HOURS)

The human chromosome, Mendelian Laws, chromosome abnormalities - Genotype and allelic frequencies-Inborn-errors of metabolism - polygenic and multifactorial inheritance, Sex determination - Role of Y chromosome - Mutation - Gene mutation.

# UNIT V - CELL AND TISSUE CULTURE

# (9 HOURS)

Introduction, primary and established cell lines, Kinetics of cell growth, Interaction among cells, genetics of cultured cells, Metabolism, Animal cell and tissue culture, Animal tissue culture media, biology of Stem cells, apoptosis, cell to cell interaction and communication.

# TEXT BOOKS

- 1. De Robertis, E.D.P. and De Robertis, E.M.F., Cell and Molecular Biology, Lippincott Williams & Wilkins, Philadelphia, USA, 8th Edition, 2010.
- Gerald Karp, Cell and Molecular Biology Concepts and Experiments, John Wiley & Sons, USA, 7<sup>th</sup> Edition, 2013.
- 3. Gardner, E.J., Simmons, M.J. Snustad, D.P. Principles of Genetics Wiley-India Ltd, New Delhi , 8th Edition, 2008.
- 4. John Kuo, Electron Microscopy: Methods and Protocols, Humana Press, 3<sup>rd</sup> Edition 2013
- 5. Strachan, T., and Read A.P. Human Molecular Genetics, Garland Publishing, 3rd Edition, 2004.
- 6. Gupta.M.L, and Jangir.M.L.,Cell biology fundamentals and Applications, 2<sup>nd</sup> edition, 2001

# THEORY COURSES

PME19D201HUMAN ANATOMV AND DHVSIOLOCV		L	Т	Р	Credit
DWEIGK2011UWIAN ANATOWIT AND THISIOLOGI		3	0	0	3
Pre-requisite: Nil	Course (	Categ	ory: I	Progra	um core

Course Type: Theory

### **Objective**(s)

- 1. Know basic structural and functional elements of human body.
- 2. Learn organs and structures involving in system formation and functions.
- 3. Understand all systems in the human body.

### **Course Outcome(s)**

At the end of this course, students will be able to

- **CO1** Describe basic building blocks of human body and can identify the anatomical position of each organs.
- CO2 Explain different types and properties of muscular and skeletal system
- CO3 Categorize the organs and its functions associated with circulation of blood
- **CO4** Demonstrate the passage of neural signals within the human body
- **CO5** Compare the physiology of the special senses and can describe the mechanism involved in Urinary system

Mapping of COS and 1 05												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Μ											
CO2		L	Н									
CO3			М									
CO4	Μ		L									
CO5	М			L								

#### **UNIT I - CELL, TISSUE AND ORGANS**

Manning of COs and Pos

Membrane potential, Nernst equation, GHK equation, Action Potential. Introduction to human body, Anatomical position: terminology, regions and planes. Blood Cells - RBC, WBC, Platelets, Blood grouping and Blood Transfusion, Immune Response

#### UNIT II - MUSCULAR AND SKELETAL SYSTEM

**Muscular System**: Type of muscles, properties of muscles (excitability and contractility, all or none law, refractory period, fatigue and elasticity)

**Skeletal System & Joints**: Types of bones, classification, Structure and composition of bone, cartilage, tendon, ligament, Classification of joints, structure of synovial joint, major joints of the body

#### UNIT III - CARDIAC AND RESPIRATORY SYSTEM (9 HOURS)

**Circulatory System:** Structure and function of heart, blood vessels, Heart valves and sounds, Cardiac cycle, Cardiac output, Coronary, systematic and pulmonary circulation, Blood Pressure and feedback control

**Respiratory system:** Respiratory pathways (upper and lower), Mechanism of respiration, respiratory membrane and gaseous exchange, Pulmonary function test, feedback control mechanism of respiration.

### **UNIT IV - NERVOUS SYSTEM**

Structure of a Neuron - Types of Neuron. Synapses and types. Conduction of action potential in neuron.

Brain – Divisions of brain lobes and its functions - EEG.

**Spinal cord** – Tracts of spinal cord - Reflex mechanism - Types of reflex. Autonomic nervous system and its functions.

# UNIT V - URINARY AND SPECIAL SENSORY SYSTEM (9 HOURS)

**Urinary system**: Structure of Kidney and Nephron. Mechanism of Urine formation and acid base regulation - Urinary reflex - Skin and sweat glands - Homeostasis

**Special senses**: Structure of Eye - Retina - Photochemistry of Vision - Accommodation Neurophysiology of Vision - EOG. Structure and functions Internal Ear - Mechanism of Hearing - Auditory pathway, Hearing Tests.

### TEXT BOOKS

1. Ross and Wilson, "Anatomy and Physiology in Health and Illness", ELBS pub, 2010.

2. Guyton and Hall, "Textbook of Medical Physiology, 12th ed.", Saunders, 2011.

### (9 HOURS)

#### (9 HOURS)

(9 HOURS)

3. Tortora and Grabowski, "Principles of Anatomy and Physiology", Wiley, 2011.

# **REFERENCES**

- 1. Gillian Pocock, Christopher D. Richards, The human Body An introduction for Biomedical and Health Sciences, Oxford University Press, USA, 2009
- 2. William F.Ganong, "Review of Medical Physiology", 22<sup>nd</sup> Edition, Mc Graw Hill, New Delhi, 2005
- 3. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", W.B. Saunders Company, Harcourt Brace Jovanovich, 2003.

RMF18P202	L	Т	Р	Credit							
DWIE10K202	3	0	0	3							
Pre-requisite: Nil Course Category: Program of											
Course Type: Theory											
<b>Objective</b> (s)	Introduce the studer	ts about applying the pr	rinciples of	che	mistry	/ with					
	carbohydrates, lipids,	protein, nucleic acids, hor	mones, and	enzy	ymes	in the					

#### biological systems. Course Outcome(s)

The Student will be able to

- **CO1** Describe the principles governing the complex interactions of chemicals in living system
- **CO2** Understand the importance of carbohydrates and vitamins in cellular machinery
- **CO3** Describe the structure of proteins and elucidate the clinical significance of biological catalysts
- **CO4** Understand the structure of various lipids and its derivatives with their implications in physiology
- **CO5** Elucidate the different bonds and structural components of nucleic acids

Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Н											
CO2		Н		Η	Η							
CO3		Н		Η	Η	L						
CO4		Н		Н	Н							
CO5		Η		Н	Η							

#### UNIT I - BASIC PRINCIPLES AND CHEMISTRY OF LIFE

#### (9 HOURS)

Solution of non electrolytes& Electrolytes: Concentration expressions, ideal solutions, colligative properties. Arrhenius theory, Bonds: ionic bonding, Ion-dipole, covalent, H-bonds, Vander Waal's interaction, Hydrophobic and hydrophilic interactions. Water as a biological solvent; Calculation of pH, Henderson-Hasselbalch equation, concept and strength of buffer,

acid-base balance; isotopes and their use in medicine and medical imaging.

# **UNIT II - CARBOHYDRATES AND VITAMINS**

Classification and structure of monosaccharides, disaccharides, Polysaccharides: structural polysaccharides and storage polysaccharides. Reactions of monosachharides.Disorders of carbohydrate metabolism. Diagnosis of diabetes mellitus. Carbohydrate chemistry in blood typing. Vitamins, Fat soluble and water soluble vitamins; Classification, structures and physiological functions.

# **UNIT III – AMINOACIDS, PROTEINS AND ENZYMES**

Structure and characteristics of amino acids. Peptide bond. Structural organization of proteins primary, secondary, tertiary, quaternary and subunit structure of protein - Conformation of proteins: Globular and fibrous proteins. Disorders of amino acid metabolism. Diagnostic enzymes: Clinical significance of Asparatate aminotransferase, Alanine aminotransferase, Lactate dehydrogenase.

# **UNIT IV – LIPIDS AND HORMONES**

Structure, and properties classification of lipids, fatty acids, triglycerides, waxes, phospholipids, cerebrosides, lipoproteins and gangliosides- Prostaglandins and their physiological implications-Steroids and bile acids. Disorders of lipid metabolism. Hormones and their biological functions.

# **UNIT V - NUCLEIC ACIDS**

Structure of purines, pyrimidine, nucleosides and nucleotides - phosphodiester and hydrogen bonds. Histones - Watson and Crick model of DNA, Types of RNA. Disorders of purine and pyrimidine metabolism, diagnosis of genetic disorders.

# **TEXT BOOKS**

- 1. Nelson.D.L, Cox. M. M., Lehningers Principle of biochemistry, 5th ed. Freeman, 2008.
- 2. Murray. R.K., Granner, D.K., Mayes. P. A. and Rodwell, V.W., Harpers Biochemistry, McGraw Hill, 27<sup>th</sup> Edition, 2006.

# REFERENCES

- 1. Berg. J.M., Tymoczko.J.L., Stryer, L., Biochemistry, Freeman, 6th edition, 2006.
- 2. Harper's Biochemistry 26th edition. McGraw Hill, 2003 Voet, D., Voet, G., Biochemistry, John Wiley and Sons, Singapore, 3<sup>rd</sup>Edition, 2001.
- 3. Berg. J.M., Tymoczko.J.L., Stryer, L., Biochemistry, Freeman, 6th edition, 2006.
- 4. Harper's Biochemistry 26th edition. McGraw Hill,2003
- 5. Voet, D., Voet, G., Biochemistry, John Wiley and Sons, Singapore, 3<sup>rd</sup>Edition, 2001.

# BME18R301DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS

# **Pre-requisite: BME18R252**

**Objective(s)** To know the various bio-potential recordings so as to enable students to record various bio-signals.

# **Course Outcome(s)**

**CO1** To know the various functional blocks present is cardiac care units so that the students

#### (9 HOURS)

(9 HOURS)

(9 HOURS)

#### (9 HOURS)

Cre Р L Т dit 3 0 0 3

**Course Type**: Theory



can handle these equipments with care and safety.

**CO2** Understand the medical devices applied in measurement of parameters related to cardiology, neurology and the methods of continuous monitoring and transmitting them.

**CO3** Apply the knowledge of communication engineering in medical field.

CO4 Learn to measure the signals generated by muscles

**CO5** Understand the need and use of some of the extracorporeal devices, thermography and laser equipments.

Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Н					L						
CO2		L										
CO3					М		L					
CO4			Н									
CO5				М								

#### **UNIT I CARDIAC EQUIPMENT (9 HOURS)**

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, Plethysmography. Cardiac Pacemaker- Internal and External Pacemaker- Batteries, AC and DC Defibrillator- Internal and External

#### UNIT II NEUROLOGICAL EQUIPMENT

#### (9 HOURS)

(9 HOURS)

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

### UNIT II SKELETAL MUSCULAR EQUIPMENT

Generation of EMG, recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation.

# UNIT IV PATIENT MONITORING AND BIOTELEMETRY (9 HOURS)

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

### UNIT V EXTRA CORPOREAL DEVICES AND SPECIAL DIAGNOSTIC TECHNIQUES (9 HOURS)

Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenerators, finger pump, roller pump, electronic monitoring of functional parameter. Hemo Dialyser unit, Lithotripsy, Principles of Cryogenic technique and application, Endoscopy, Laproscopy. Thermography – Recording and clinical application, ophthalmic instruments.

### TEXT BOOKS

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2014

# **REFERENCES**

- 1. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", Mc Graw Hill, 2003.
- 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, Principles and design", Charles Thomas
- 5. Publisher Ltd, Illinois, USA, 2008.
- 6. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson education, 2004.
- 7. John G.Webster, "Medical Instrumentation Application and Design", third edition, John Wiley and Sons, New York, 2006.

BME18R401BIOMEDICAL IMAGE PROCESSING AND ANALYSIS	L	Т	Р	Credit					
	3	0	0	3					
Pre-requisite: Riomedical Signal Processing RME18R371 Course Category: Program core									

Pre-requisite: Biomedical Signal ProcessingBME18R371Course Category: Program coreCourse Type: TheoryCourse Category: Program core

**Objective(s)** It presents a systematic overview of principles and systems of biomedical imaging and fundamental image processing and visualization methods. equip with knowledge to select proper imaging modalities for specific clinical and research purposes, with the understanding of their strengths and limitations.

### Course Outcome(s)

**CO1** Understand x-ray, ultrasound, and magnetic resonance interactions with tissue and the various components of imaging systems.

CO2 Use fundamentals of mathematics and physics to analyze image data.

CO3 Understand modern imaging devices and their application in medicine and industry.

**CO4** Demonstrate understanding of image data collection, resolution, reconstruction, storage, processing, visualization, fusion, and communication.

**CO5** Develop a competence in the Fundamental analytical and computational tools used in medical imaging.

Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Н	Н	L									
CO2		Н			L							
CO3		Н										
CO4		М		L								

**UNIT I DIGITAL IMAGE FUNDAMENTALS** 

Elements of digital image processing systems, Elements of Visual perception, Image sampling and quantization, - Some Basic relationships between pixels, Matrix and Singular Value representation of discrete images.

#### **UNIT II IMAGE TRANSFORMS**

1D DFT, 2D DFT, Cosine, Sine Hadamard, Haar, Slant, KL transform and their properties.

# **UNIT III IMAGE ENHANCEMENT**

Histogram – Modification and specification techniques, Enhancement by point processing Image smoothening, Image sharpening, generation of spatial masks from frequency domain specification, Homomorphic filtering and color image processing.

### UNIT IV IMAGE RESTORATIONAND RECONSTRUCTION OF MEDICAL IMAGES

#### (15 HOURS)

(15 HOURS)

(15 HOURS)

Image degradation models, Unconstrained and Constrained restoration, inverse filtering, Least mean square filter, Image reconstruction from projections - Radon transforms, Filter back projection algorithm, 3D tomography, Fourier reconstruction of MRI Images.

#### **UNIT V MEDICAL IMAGE COMPRESSION TECHNIQUES** (15 HOURS) Run length, Huffman coding, arithmetic coding, Pixel coding, transform coding, JPEG Standard,

predictive techniques, Application of image processing techniques in thermography, SPECT, PET images.

### **TEXT BOOKS**

1. Rafael C., Gonzalez and Richard E. Woods, Digital Image Processing, Pearson Education Asia, 2001

2. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 1997

# **REFERENCE BOOKS**

- 1. William K. Pratt, Digital Image Processing, John Wiley, NJ, 1987.
- 2. Albert Macouski, Medical Imaging systems, Prentice Hall, New Jersey. 1983.
- 3. Sid Ahmed M.A., Image Processing Theory, Algorithm and Architectures, McGraw Hill, 1995.
#### THEORY WITH PRACTICE

BME19D251	BIOCONTROL SYSTEMS	L	Т	Р	Credit				
DWIE10K251	<b>BIOCONTROL STSTEMS</b>	3	0	1	3.5				
Pre-requisite: NIL	Course Category: Program core								
	<b>Course Type</b> : Theory with practical								

**Objective(s)** Analyze the time and frequency domains of the given system using different mathematical techniques

#### Course Outcome(s)

**CO1** To understand the concept and different mathematical techniques applied in analyzing any given system

CO2 To learn the analysis of given system in time domain and frequency domain

- CO3 To understand the stability analysis of the given system
- CO4 To analyse various state space representations
- **CO5** To understand the concept of physiological control system

	Mapping of COs and Pos											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Н		L	М								
CO2	Μ			М	Н							
CO3			L									
CO4					Н							
CO5		Н										

#### **UNIT I MODELING OF SYSTEMS**

# Terminology and basic structure of control system, example of a closed loop system. Laplace transforms - Definition-Properties-Laplace transform of periodic functions-Laplace transform of unit step function, Impulse function -Inverse Laplace transform. Transfer functions, modeling of electrical systems, translational and rotational mechanical systems, and electromechanical systems, block diagram and signal flow graph representation of systems, conversion of block diagram to signal flow graph, reduction of block diagram and signal flow graph.

#### UNIT II TIME RESPONSE ANALYSIS

Step and impulse responses of first order and second order systems, determination of time domain specifications of first and second order systems from its output responses, definition of steady state error constants and its computations.

#### UNIT III STABILITY AND STATE SPACE ANALYSIS

Definition of stability, Routh- Hurwitz criteria of stability, root locus technique, construction of root locus and study of stability, definition of dominant poles and relative stability. State Space Theory: Introduction, State & state variables, Selection of state variables, state model, Non-homogenous solution, converting a transfer function to a state model.

#### UNIT IV FREQUENCY RESPONSE ANALYSIS

Frequency response, Nyquist stability criterion, Nyquist plot and determination of closed loop

## (12 HOURS)

(12 HOURS)

(12 HOURS)

#### (12 HOURS)

stability, definition of gain margin and phase margin, Bode plot, determination of gain margin and phase margin using Bode plot, use of Nichol's chart to compute response frequency and bandwidth.

#### UNIT V PHYSIOLOGICAL CONTROL SYSTEM

#### (12 HOURS)

Example of physiological control system: Thermoregulatory system, muscle stretch reflex, difference between engineering and physiological control systems, generalized system properties, models with combination of system elements, linear models of physiological systems-Examples

#### TEXT BOOKS

1. M. Gopal "Control Systems Principles and Design", Tata McGraw Hill, 2002 (Units I, II, III & IV).

2. Michael C K Khoo, "Physiological Control Systems", IEEE Press, Prentice Hall of India, 2001(Unit V).

#### **REFERENCES**

- 1. Benjamin C.Kuo, "Automatic control systems", john wileys's and sons, 9<sup>th</sup> edition 2009. ISBN: 9788126552337.
- 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.

#### PRACTICAL

- Closed loop control of ac,dc servo motor, tachogenerator and synchros using MATLAB Software.
- Time Response using MATLAB Software.
- Root locus technique by MATLAB Software.
- Bode plot using MATLAB Software.
- Frequency response analysis using MATLAB Software.

RME18D252RIOMEDICAL INSTRUMENTATION	L	Т	Р	Credit						
DWIE10K252DIOWIEDICAL INSTRUMENTATION	3	0	1	3.5						
Pre-requisite: Basic Electrical and Electronics Engineering EEE18R171										
Course Category: Program core										

**Course Type**: Theory with Practice

**Objective(s)** To gain basic knowledge about Bio potentials, Bio electrodes and bio amplifiers and to give a complete exposure of various recording mechanism and to understand the basic principles, working of biomedical instruments.

#### Course Outcome(s)

**CO1** To learn several signals that can be measured from the human body.

CO2 To study different types of electrodes used in bio-potential recording.

**CO3** To understand how noise from the environment, instruments and other physiologic systems can create artifacts in instrumentation.

CO4 To understand the theory of how several sensors operate and use these sensors in practical.

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	Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	Η												
CO2		L											
CO3			Н			Н							
CO4							L						
CO5			М			Н		Н				Н	

**CO5** To design the medical instrument to measure non electrical and analytical parameters.

#### **UNIT I - BIOPOTENTIAL AND ELECTRODES**

Components of Medical Instrumentation System- Basic Cell Functions, Origin of Biopotentials, Electrical Activity of Cells, Electrode-Electrolyte interface, half-cell potential, Polarizationpolarizable and non-polarizable electrodes, Ag/AgCl electrodes, Electrode and Skin interface and motion artifact. Body Surface recording electrodes for ECG, EMG, EEG.

#### **UNIT II - BIOELECTRIC SIGNALS RECORDING AND BIOAMPLIFIERS**

#### (9 HOURS)

(9 HOURS)

Recording of ECG, EEG and EMG - Einthoven triangle, Standard 12-lead configurations - ECG Machine - EMG machine - 10-20 electrodes placement system for EEG - EEG machine. Bioamplifiers- Carrier Amplifier - Isolation Amplifier - Differential amplifier - Chopper Amplifier - Instrumentation Amplifier

**UNIT III - MEASUREMENT OF NON-ELECTRICAL PARAMETERS** (9 HOURS) Human body Temperature, Measurement of blood pressure – Cardiac output – Heart rate – Heart sound - Pulmonary function measurements - spirometer - Photo Plethysmography, Body Plethysmography – Blood Gas analysers : finger-tip oxymeter - ESR, GSR measurements. (9 HOURS)

#### **UNIT IV - LIFE SUPPORT INSTRUMENTS**

Pacemaker-Types of Pacemaker, mode of pacing and its application, Defibrillator-AC and DC Defibrillators and their application, Heart Lung machine and its application during surgery, Haemodialysis system and the precautions to be taken during dialysis.

#### **UNIT V - ANALYTICAL INSTRUMENTAION AND ELECTRICAL SAFETY:**

#### (9 HOURS)

Principle of colorimetry, photometry and pН measurement. Spectrophotometer; Spectrofluorometer; pH meter. Blood Cell counter; Biochemical analyzers; Na-K analyzer Physiological effects of electrical current, Shock Hazards from electrical equipment and methods of accident prevention

#### **PRACTICALS**

- Recording of ECG, EEG and EMG.
- Design of Biological preamplifier.
- Optical Isolation amplifier.
- Recording of various physiological parameters using patient monitoring system.

• pH measurement.

RME18B351BIOMECHANICS		L	Т	Р	Credit			
DWEIGKSSIDIOWIECHANICS	3	0	1	3.5				
Pre-requisite: BME18R201	Course Category: Program							
c	coreCourse Type: Theory with							
F	practical							

#### **Objective**(s)

- 1. Be exposed to principles of mechanics of physiological systems.
- 2. Be familiar with the mathematical models used in the analysis of biomechanical systems

#### Course Outcome(s)

At the end of this course, students will be able

- **CO1** To describe movement (kinematics) and to consider the role of force in movement (kinetics)
- CO2 Analyze the mechanical principles of biofluids
- **CO3** Illustrate the techniques behind Biosolid mechanics
- **CO4** Design devices to meet the orthopaedic applications.
- **CO5** Model new devices to meet many applications considering ergonomics

	Mapping of COs and Pos											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Н		Н									
CO2	Μ											
CO3		М	Н									
CO4		М	Н	М	L							
CO5			Н	М	М	L	Μ					

#### **UNIT I INTRODUCTION TO MECHANICS**

### (12 HOURS)

Principles of Mechanics, Vector mechanics, Mechanics of motion - Newton's laws of motion, Kinetics, Kinematics of motion, Fluid mechanics – Euler equations and Navier Stoke's equations, Viscoelasticity, Constitutive equations, Stress transformations, Strain energy function.

#### UNIT II BIOFLUID MECHANICS

Introduction, viscosity and capillary viscometer, Rheological properties of blood, laminar flow, Couette flow and Hagen-Poiseuille equation, turbulent flow. Cardiovascular system - biological and mechanical valves development, artificial heart valves testing of valves, Structure, functions, material properties and modelling of Blood vessels.

#### UNIT III BIOSOLID MECHANICS

Hard Tissues: Bone structure & composition mechanical properties of bone, cortical and cancellous bones, viscoelastic properties, Maxwell & Voight models – anisotropy. Soft Tissues: Structure, functions, material properties and modelling of Soft Tissues: Cartilage, Tendon,

#### (12 HOURS)

(12 HOURS)

#### Ligament, Muscle.

#### UNIT IV BIOMECHANICS OF JOINTS AND IMPLANTS (12 HOURS)

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, spinal column, hip knee and ankle. Design of orthopaedic implant, specifications for a prosthetic joint, biocompatibility, requirement of a biomaterial, characteristics of different types of biomaterials, manufacturing process of implants, fixation of implants.

#### **UNIT V MODELLING AND ERGONOMICS**

#### (12 HOURS)

Introduction to Finite Element Analysis, Analysis of bio mechanical systems using Finite element methods, Graphical design. Ergonomics- Gait analysis, Design of work station, Sports biomechanics, Injury mechanics.

#### TEXT BOOKS

- 1. Duane Knudson, "Fundamentals of Biomechanics", Second Edition Springer Science+Business Media, 2007
- 2. Marcelo Epstein, "The Elements of Continuum Biomechanics", ISBN: 978-1-119-99923-2, 2012.
- **3.** Fung, Y.C. "Biomechanics Mechanical Properties of Living Tissues", New age international, ISBN: 978-81-8128-811-0, 2007

#### **REFERENCES**

- 1. Jay D. Humphrey, Sherry De Lange, "An Introduction to Biomechanics: Solids and Fluids, Analysis and Design", Springer Science+Business Media, 2004.
- 2. Shrawan Kumar, "Biomechanics in Ergonomics", Second Edition, CRC Press 2007.

#### PRACTICAL

- Tissue Mechanics
- Biomaterial Testing
- Posture Analysis
- Gait Analysis
- Cardiovascular Implant Testing
- Exercise Biomechanics

RME18B352DATHOLOCY AND MICBORIOLOCY	L	Т	Р	Credit
DWEI0K3521 ATHOLOGT AND WICKODIOLOGT	3	0	1	3.5
Pre-requisite: NILCourse Category: Program core				
Course Type: Theory				

#### **Objective**(s)

- 1. Attain knowledge on the structural and functional aspects of microorganisms that interferes with the health of living organisms.
- 2. Know the etiology and remedy in treating the pathological diseases.

#### **Course Outcome(s)**

At the end of this course, students will be able to

- CO1 Illustrate the different types of Cell degeneration, how and when it gets repaired
- CO2 Demonstrate the different pathologic conditions related to the body fluids
- CO3 Compare the structure and function of different types of microorganisms.
- **CO4** Demonstrate the various culture techniques for growing microbes and to visualize them through staining
- **CO5** Interpret the response of human body when a microbe enters the human system and the techniques to confirm the presence of microbe.

	Mapping of COs and Pos											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			М	L								
CO2	L		М									
CO3	М											
CO4					М	Н						
CO5					М	Н						

UNIT I - CELL DEGENERATION, REPAIR AND NEOPLASIA (9 HOURS) Cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification, cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumors, carcinogenesis, spread of tumors. Autopsy and biopsy.

UNIT II - FLUID AND HEMODYNAMIC DERRANGEMENTS (9 HOURS) Edema, normal haemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock. Hematological disorders - Bleeding disorders, Leukaemia, Lymphomas.

#### UNIT III - STRUCTURE AND FUNCTION OF MICRO ORGANISMS (9 HOURS)

Structure of the bacterial cell wall, appendages of bacteria - Pili and flagella, capsule, slime and bacterial endospores, Over view of Viruses, Structure and classification, multiplication of fungi, Life history of yeast and bacteriophages.

#### **UNIT IV - MICROBIAL GROWTH**

Growth curve of bacteria, identification of bacteria , culture media and its types , culture techniques and observation of culture. Principle of Light and electron Microscope. Staining techniques: Simple, Gram and AFB staining.

#### **UNIT V - IMMUNOLOGY**

Natural and artificial immunity; Innate and acquired immunity, opsonization, phagocytosis, inflammation, Immune deficiency syndrome, antibodies and its types; antigen and antibody reactions, immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, monoclonal antibodies. Disease caused by bacteria, fungi, protozoal, virus and helminthes.

#### TEXT BOOKS

1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of Diseases", 7th edition, WB Saunders Co. 2005 (Units I & II).

## (9 HOURS)

(9 HOURS)

#### 43

2. Prescott, Harley and Klein, "Microbiology", 7th edition, McGraw Hill, 2007 (Units III, IV and V)

#### **REFERENCES**

- 1. Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3rd edition, 2000.
- 2. Ananthanarayanan&Panicker, "Microbiology" Orientblackswan, 2005.
- 3. Dubey RC and Maheswari DK. "A Text Book of Microbiology" Chand & Company Ltd, 2007.

#### **PRACTICALS**

- 1. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)
- 2. Histopathological slides of benign and malignant tumours.
- 3. Haematology slides of anemia and leukemia
- 4. Slides of malarial parasites, micro filaria and leishmania donovani.
- 5. Various staining techniques: Simple, Gram and AFB staining.
- 6. Manual paraffin tissue processing and section cutting (demonstration)

#### **INTEGRATED THEORY WITH PRACTICAL**

RME18D271ANALOC AND DICITAL ELECTRONICS		L	Т	Р	Credit
DWIE16K2/TANALOG AND DIGITAL ELECTRONICS		3	0	2	4
Pre-requisite: Nil	Course C	atego	ory: P	rogra	am core
Course Type: Integrated Course					

#### **Objective**(s)

- 1. To provide an overview of principle, operation and application of analog building blocks like BJT, FET and MOSFET for performing various functions.
- 2. To understand, analyze and design new circuit based medical devices utilizing both analog and digital integrated circuits.

#### **Course Outcome(s)**

At the end of this course, students will be able

- Toanalyze the characteristics and various configurations of BJT, FET and MOSFET **CO1**
- CO2 To discuss the principles of feedback amplifiers and utilization of oscillators
- **CO3** To study the circuit configuration and practical applications of linear integrated circuits
- **CO4** To learn the number systems and to design various combinational digital circuits using logic gates
- **CO5** To design sequential logic circuit using state table and state diagram

Mapp	Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	Μ												
CO2		L	L	М									
CO3	Η	М	М										
CO4	Μ												
CO5	Η	Μ											

#### **UNIT I BJT & FET AMPLIFIERS**

#### Fundamentals of Diodes and Transistors - biasing circuits for BJT - DC - AC Load linear stability factor analysis - temperature compensation methods - biasing circuits of FET's -MOSFET's - FET - MOSFET amplifiers - analysis & design of CC - CE - CB configurations -RC coupled & transformer coupled multistage amplifiers - frequency response of amplifiers analysis & design of CS, CD, CG amplifier, thermal runaway in BJT & FET amplifiers. (12 Hours)

(9 Hours)

UNIT II OSCILLATORS APPLICATIONS

46

Introduction-Low pass and High pass filters- Design of first and second order Butterworth low pass and high pass filters Band pass, Band reject and all pass filters- Oscillator types and principle of operation – RC, Wien bridge oscillators triangular, saw-tooth, square wave and VCO- Introduction to voltage regulators, features of 723, Three Terminal IC regulators- DC to DC Converter- Switching Regulators-UPS-SMPS.

#### UNIT III OPERATIONAL AMPLIFIERS

The characteristics of Ideal Operation – slew rate, offset voltage, bias current, CMRR, bandwidth - equivalent circuit of an op-Amp – virtual ground concept – Linear applications of op-amp – inverting and non inverting amplifier, summing, subtracting, averaging amplifier - voltage to current converter – current to voltage converter – Differential amplifiers – differentiator and integrator. Nonlinear applications – comparator – Schmitt Triggers – Precision Diode, Half wave and full wave rectifiers – Average detectors – peak detector

#### UNIT IV NUMBER SYSTEMS AND LOGIC GATES

Decimal, Binary, Octal and Hexadecimal Numbers.-Conversion between these number systems.-Complements r's and (r-1)'s complements.- subtraction using complements – Encoding numbers and characters using Binary digits. –Binary coded Decimal –Gray code - Binary to Gray code conversion –ASCII Code.

**Logic gates** – Truth tables – NOT, AND, OR, NOR, NAND, XOR, XNOR - Boolean Laws and theorems – Solving Boolean expressions, Truth Tables and Logic circuits – The Karnaugh Map – half adder, full adder, Multiplexers and Demultiplexers - Decoders and encoders.

#### **UNIT V REGISTERS AND COUNTERS**

#### (12 Hours)

Flip Flops – RS, D, T, JK Flip Flops – Characteristic equations, exciting tables – JK Master – Slave flip-flop – Universal shift register. Design of modulo-N counters – counter design using state diagram.

#### TEXT BOOKS

- 1. Jacob Millman and Christos C. Halkias, Electronic Devices and Circuits, Tata McGraw-Hill, 3<sup>rd</sup> edition, 2010.
- 2. David A. Bell., Electronic Devices and Circuits, Prentice Hall of India, 5<sup>th</sup> Edition, 2008.
- 3. M. Morris Mano, "Digital Logic and Computer design " Prentice Hall 2004.
- 4. Ramakant A. Gayakwad, "Op-AMP and Linear ICs", 4<sup>th</sup> Edition, Prentice Hall, 2000.

#### **REFERENCES**

- 1. Donald A .Neaman, Semiconductor Physics and Devices, Tata McGraw-Hill, 3<sup>rd</sup> edition, 2002
- 2. Salivahanan. S., et al., Electronic Devices and Circuits, Tata McGraw Hill, 1<sup>st</sup> edition, Reprint 2001.
- 3. Robert B.Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.
- 4. Sergio Franco, "Design with Operational Amplifiers and analog Integrated circuits", McGraw-Hills, 2003.
- 5. Millman J and Halkias .C. "Integrated Electronics", TMH, 2007.

## (12 Hours)

(12 Hours)

- 4. John. F. Wakerly, "Digital Design Principles and Practices", Fourth Edition, Pearson Education, 2007.
- 6. Charles H. Roth, Jr, "Fundamentals of Logic Design", Fourth Edition, Jaico Books, 2002

#### LIST OF EXPERIMENTS

- 1. Study the static input and output characteristics of CB, CC and CE transistor.
- 2. Study the drain and Transfer Characteristics of JFET.
- 3. Determine the frequency of RC phase shift oscillator.
- 4. Inverting, non-inverting amplifier.
- 5. Integrator and Differentiator.
- 6. Current to Voltage convertor and Voltage to Current Convertor.
- 7. Comparator, Peak detector and Average detector.
- 8. Multivibrator using IC555 Timer.
- 9. Verify the Truth Table of all Basic, Universal and Special gates.
- 10. Design a Half Adder using EX-OR, AND and NOT gate verify the Truth Table.
- 11. Study Full Adder and Subtractor and verify the Truth Table.
- 12. Design RS, JK, D and T Flip-Flop and verify the Truth Table.
- 13. Study and design Multiplexer and Demultiplexer.

#### Mini Project has to be done by students based on the laboratory techniques studied. Assessment will be done based on the Project report and functioning of the design.

RME18D272RIOSENSODS AND TRANSDUCEDS	L	Т	Р	Credit
DME18K272DIOSENSOKS AND I KANSDUCEKS	3	0	2	4

Pre-requisite: Analog and Digital Electronics BME18R271Course Category: Program coreCourse Type: Integrated Course

#### **Objective**(s)

- 1. Understand the purpose of measurement, the methods of measurements, errors associated with measurements.
- 2. Know the principle of transduction, classifications and the characteristics of different transducers and study its Biomedical applications.

#### Course Outcome(s)

Upon completion of the course, the student should be able to:

- **CO1** Describe the different types of transducers and its purposes.
- CO2 Explain variety of photoelectric transducers.
- CO3 Describe the principle and operation of inductive and capacitive transducers.
- CO4 Discuss about various chemical biosensors and smart sensors.

Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Μ	Н	Η									
CO2		М										
CO3		М										
CO4			Μ	М	Н	L						
CO5	L				Н							L

**CO5** Discuss about signal conditioning, display and recording devices.

#### UNIT I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS (15 HOURS)

Units and standards –Calibration methods –Static calibration –Classification of errors:-Limiting error and probable error –Error analysis:–Statistical methods –Odds and uncertainty – Classification of transducers –Selection of transducers – Characteristics of transducers: Static characteristics, Dynamic characteristics.

# UNIT II VARIABLE RESISTANCE AND PHOTOELECTRIC TRANSDUCERS (15 HOURS)

Principle of operation, construction details, characteristics and applications of potentiometerstrain gauge- resistance thermometer- Thermistor- Thermocouple Piezoelectric transducer -Hall Effect transducer - piezo-resistive sensor -Photoelectric transducers: photovoltaic cells and photoemissive cells.

#### UNIT III VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS (15 HOURS)

Inductive transducers: Principle of operation, construction details, characteristics and applications of LVDT, induction potentiometer - characteristics of capacitive transducers – Different types - Applications: Capacitor microphone, Capacitive pressure sensor, Proximity sensor.

# UNIT IV CHEMICALBIOSENSORS AND SMART SENSORS (15 HOURS)

Biochemical sensors - enzymatic biosensors, pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyser - Smart sensors -Fibre optic sensors-Introduction to MEMS and Nano sensors.

#### UNIT V SIGNAL CONDITIONING, DISPLAY AND RECORDING DEVICES

#### (15 HOURS)

AC and DC Bridges –wheat stone bridge, Kelvin, Maxwell, Hay, Schering- Multi meter – CRO – DSO- LCD monitor- Recorders –Analog and Graphic Recorders-Strip Chart Recorder-X-Y Recorder- photographic recorder-Magnetic tape recorder.

#### TEXT BOOKS

1. A.K.Sawhney, "Electrical & Electronics Measurement and Instrumentation", 10th edition, Dhanpat Rai & Co, New Delhi, 2010.

2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.

#### **REFERENCES**

- 1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
- 2. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004.
- 3. Neubert H.K.P., Instrument Transducers –An Introduction to their Performance and Design, Oxford University Press, Cambridge, 2003.
- 4. Doebelin E.O. and Manik D.N., Measurement Systems –Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.
- 5. D. Patranabis, Sensors and Transducers, 2<sup>nd</sup> edition, Prentice Hall of India, 2010.E.A.
- 6. Murthy, D.V.S., Transducers and Instrumentation, 2<sup>nd</sup> Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.

#### LIST OF EXPERIMENTS

- 1. Measurement of Pulse Rate using photo transducer
- 2. Measurement of Respiratory Rate using temperature transducer
- 3. Measurement of displacement using capacitive transducer and Inductive transducer
- 4. Measurement of SpO2 using optical transducer
- 5. Measurement of skin temperature by both contact and non-contact method
- 6. Measurement of chemical compounds using Load Cell
- 7. Measurement of blood glucose measurement using amperometric sensor
- 8. Non-invasive gas analyzer as an electronic nose
- 9. Measurement of blood  $P^H$  using  $P^H$  electrode
- 10. Study of electronic stethoscope.

EEE18R371MICROPROCESSOR AND MICROCONTROLLER	L	Т	Р	Credit
	3	0	2	4

#### Pre-requisite: NILCourse Category: Program core

#### **Course Type: Integrated Course**

#### **Course Objective(s):**

To develop an in-depth understanding of the operation of microprocessors and microcontrollers, machine language programming & interfacing techniques. Developing of assembly level programs and providing the basics of the processors.

#### **Course Outcome(s):**

After completing this course, the student will be able to:

CO1:Describe fundamental of Microprocessor and Microcontrollers

- **CO2:**Illustrate the architecture and analyze the instruction sets, programming of 8-bit microprocessor 8085.
- CO3:Study the different peripheral devices and their interfacing to 8085

CO4:Illustrate the architecture of 8051 microcontroller.

	Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1			S	S								S	
CO2			S	S	S				S			М	
CO3			S	S					S				
CO4			S	S	S								
CO5			S	S	S					L			

**CO5:**Study the interrupt and timers of 8051 microcontroller and design the microcontroller based control circuit for electrical and electronics applications.

UNIT I FUNDAMENTALS OF MICROPROCESSORS AND MICROCONTROLLER

#### 9 Hours and Microcontroller

Fundamentals of Microprocessor Architecture. 8-bitMicroprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.

#### UNIT II 8085 MICROPROCESSOR

8085 architecture - Instruction set - Addressing modes- Timing diagram – Assembly Language Programming - Counters time delays – Interrupts - Memory Interfacing - Interfacing I/O devices. UNIT III MICROPROCESSOR INTERFACING TECHNIOUES 9 Hours

Interfacing serial I/O (8251) – Parallel I/O (8255) – ,RS232,SPI, I2C,Introduction and interfacing to protocols like Blue-tooth and Zig-bee. Keyboard and display controller (8279) - ADC/DAC interfacing – 8257 programmable DMA controller – 8259A programmable interrupt controller.

#### UNIT IV 8051 MICROCONTROLLER

8051 microcontroller hardware – I/O Pins, Ports and circuits – external memory, 8051 Instruction set – Addressing Modes – – counters and timers – serial data input and output – interrupts – Interfacing to external memory and 8255.

#### UNIT V 8051 PROGRAMMING AND APPLICATIONS

Assembly Language Programming – I/O Port Programming – Timer and counter Programming – Serial Communication – Interrupt Programming – 8051 Interfacing, LED, ADL, Sensors – Stepper Motor - keyboard and DAC,C language programs. Assemblers and compilers. Programming and debugging tools.

#### LIST OF EXPERIMENTS (15 Hours)

- 1. Simple arithmetic operations
- 2. ADC and DAC interfacing
- 3. Arithmetic operation with 8051 micro controller execution.
- 4. Sine wave and Square wave generation

#### 9 Hours

#### 9 Hours

9 Hours

- 5. ADC and DAC interfacing
- 6. Stepper motor control
- 7. Servomotor control
- 8. Traffic light control
- 9. Seven segment display
- 10. Basic programming using keil

#### **Additional Experiments**

- 1. Simple Digital Voltmeter using 8051.
- 2. Digital lock using AT89C2051 with LCD and keypad assembly.
- 3. Data acquisition system using 8051.
- 4. Temperature controlled Fan.
- 5. Microcontroller based caller ID.
- 6. Bio medical monitoring system.
- 7. Auto Control of 3-phase Induction Motor.

#### TEXT BOOK(s):

- 1. Gaonkar, R.S., Microprocessor Architecture Programming and Application, Wiley Eastern Ltd., New Delhi, 2005.
- 2. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education, 2007.

#### **REFERENCE(s):**

- 1. Hall, D.V., Microprocessor and Interfacing Programming and Hardware, Tata McGraw Hill Publishing Company, 2nd edition, 2012.
- 2. YuCheng Liu & Glenn A Gibson, Microcomputer System, 8086/8088 Family, 2nd edition, Prentice Hall of India, 2005.
- 3. Rafiquzzaman M., Microprocessor Theory and Application Intel and Motorola, Prentice Hall of India, 2007.

DME10D271DIOMEDICAL CICNAL DDOCESSING	L	Т	Р	Credit
BME18K3/IBIOMEDICAL SIGNAL PROCESSING	3	0	2	4
Pre-requisite: NILCourse Category: Program core				
Course Type: Integrated Course				

**Objective**(s) This course introduces various bio-signal representations, various filter design and applications of adaptive filters.

#### **Course Outcome(s)**

- CO1 To understand the characteristics, basis and utility of a variety of signals
- CO2 To discuss Z Transform and Discrete Fourier transform
- CO3 To discuss about IIR filter design.
- CO4 To discuss about FIR filter design using various windowing techniques.

Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Н	Н	L									
CO2		Н			L							
CO3		Н										
CO4		М		L								
CO5		Н	М		Н							

**CO5** To understand finite word length effects in digital Filters and applications of adaptive filters.

UNIT I SIGNALS AND SYSTEMS

#### (15 HOURS)

**Introduction and Classification of signals:** Definition of signal and systems, communication and control systems as examples. Sampling of analog signals, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power. Elementary signals/Functions: exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sync functions. Operations on signals: Amplitude scaling, addition, multiplication, time scaling, time shifting and time folding.

**Systems:** Definition, Classification: linear and nonlinear, time variant and invariant, causal and noncausal, static and dynamic, stable and unstable, invertible.

# UNIT II Z TRANSFORM AND DISCRETE FOURIER TRANSFORMS (15 HOURS)

**Z-Transform:** Direct Z-Transform, Properties of the Z-Transform, Examples, Inverse Z-Transform by Partial- Fraction Expansion method - Causality and Stability.

**Introduction to DFT** – Properties of DFT – Circular Convolution - Filtering methods based on DFT – FFT Algorithms –Decimation in time Algorithms, Decimation in frequency Algorithms – Use of FFT in Linear Filtering.

#### UNIT III IIR FILTER DESIGN

Structures of IIR systems: Direct form, Cascade form, Parallel form structures – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (LPF, HPF, BPF, BRF) filter design using frequency translation.

#### UNIT IV FIR FILTER DESIGN

Structures of FIR – Linear phase FIR filter – Fourier Series - Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanning Window), Frequency sampling techniques – Implementation of FIR filters by direct form and Single-stage lattice structure.

#### UNIT V FINITE WORD LENGTH EFFECTS IN DIGITAL FILTERS AND ADAPTIVE FILTER (15 HOURS)

**Finite word length effects in digital Filters:** Errors, Limit Cycle, Noise Power Spectrum -Multirate Digital Signal Processing:Decimation and Interpolation process

**Adaptive filters** – Principle noise canceller model – 50 Hz adaptive cancelling using a sine wave model – Maternal ECG cancellation in fetal electrocardiography – ECG cancellation in EMG

#### (15 HOURS)

(15 HOURS)

recording – High frequency noise cancellation in Electro surgery. Signal averaging – Basics and limitations.

#### TEXT BOOKS

- 1. John G. Proakis& Dimitris G.Manolakis, "Digital Signal Processing Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007.
- 2. DC Reddy, Biomedical Signal Processing Principles and Techniques, Tata McGraw Hill Publishing company Ltd., 2005 (UNITS IV & V)

#### **REFERENCES**

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

#### **LIST OF EXPERIMENTS**

- 1. Representation of basic discrete time signals
- 2. IIR filters design-digital Butterworth filter and Chebyshev filter
- 3. Designing an FIR filter using window techniques in MATLAB
- 4. Signal Averaging of ECG
- 5. Noise removal in EEG signal using Chebychev filter.
- 6. Noise removal in EMG signal using Butterworth filter
- 7. Design of Notch filter for elimination of 50Hz from ECG signal.
- 8. EMG processing using MATLAB –Rectification and Signal Averaging.
- 9. Time frequency domain properties of different windows using MATLAB.
- 10. Estimation of bio-signals using Parametric Method and Non Parametric method
- 11. Detection of QRS complex of ECG signal
- 12. Estimation of ST segment and R-R interval.
- 13. Implementation of the Double-Precision Complex FFT for ECG signal.

#### LABORATORY COURSES

BME18R281BIOCHEMISTRY AND HUMAN PHYSIOLOGY		L	Τ	Р	Credit						
LABORATORY		0	0	3	2						
Co-requisite: Clinical Biochemistry BME18R233Course Category: Program coreCourse Type: Laboratory											

**Objective**(*s*) To provide practical knowledge of biological macromolecules in clinical settings

#### Course Outcome(s)

Upon completion of the course, students will be able to

**CO1** Apply the acquired knowledge on carbohydrates, proteins, neucleic acids and lipids by conducting various qualitative and quantitative analytical methods for the diagnosis of diseases

CO2 Analyse the blood for its abnormalities in diseased conditions

**CO3** Performing advanced experiments by applying the knowledge of routine laboratory tests.

Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Н											
CO2	Η	Н	L	Н	Η							
CO3				М	М							

#### LIST OF EXPERIMENTS:

- 1. General tests for carbohydrates, proteins and lipids.
- 2. Preparation of serum and plasma from blood.
- 3. Estimation of blood glucose.
- 4. Estimation of creatinine
- 5. Estimation of urea
- 6. Estimation of cholesterol
- 7. Assay of SGOT/SGPT
- 8. Separation of amino acids by thin layer chromatography (paper chromatography)
- 9. Separation of proteins by SDS electrophoresis
- 10. Separation of DNA by agarose gel electrophoresis
- 11. ESR, PCV, MCH, MCV, MCHC, total count of RBCs and hemoglobin estimation
- 12. Differential count of different WBCs
- 13. Blood group identification

BME18R381BIOMEDICAL INSTRUMENTATION	L	Т	Р	Credit
AND EQUIPMENTS LABORATORY**	0	0	3	2
Co requisite: Biomedical Instrumentation-BME18R252 Course (	Categ	ory: ]	Progra	am core

**Course Type**: Laboratory

**Objective**(s) To provide hands on training on Measurement of physiological parameters, biochemical parameters measurement and bio-signal analysis.

#### Course Outcome(s)

Upon completion of the course, students will be able to

- CO1 Understand the various bio-signal processing units like amplifiers, filters
- CO2 Measure various electrical, non-electrical, chemical biological parameters.
- CO3 Record, analysis and interrupt various bio-parameters.
- **CO4** Understand, analyse, and apply theoretical knowledge for a particular application by implementing in a mini project.

#### Mapping of COs and Pos

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Н											
CO2		L				Н						
CO3				М								
CO4						L	L			Н	М	Н

#### LIST OF EXPERIMENTS

- 1. Study of Biological Preamplifiers.
- 2. Recording of ECG signal and detection of QRS complex.
- 3. Audiometer.
- 4. Recording of EMG.
- 5. Recording of various physiological parameters using patient monitoring system and telemetry units.
- 6. Measurement of pH, pO2 and conductivity.
- 7. Study and analysis of functioning and safety aspects of surgical diathermy.
- 8. Measurement and recording of peripheral blood flow.
- 9. Measurement of visually evoked potential.
- 10. Study of Characteristics of optical isolation amplifier.
- 11. Galvanic skin response (GSR) measurement.
- 12. Study of short wave and ultrasonic diathermy.
- 13. Measurement of Respiratory parameters using spirometry.
- 14. Design of ECG amplifier, recording and analysis using LabVIEW.
- 15. Study of medical stimulator.
- 16. Electrical safety measurements.

BME19D/91	BIOMEDICAL	IMAGE	PROCESSING	AND	L	Т	Р	C
DIVIDION401	ANALYSIS LABO	<b>DRATORY**</b>			0	0	3	2
Co-requisite:I	BME18R401		Course	Catego	ry:	Progr	am	core
		Course	Type: I	Labor	atory	7		

**Objective(s)** To provide hands on training on various Medical image processing techniques. **Course Outcome(s)** 

Upon completion of the course, students will be able to

- CO1 Understand the various concepts in medical image processing.
- CO2 Learn to remove noise in the medical images.
- CO3 To compress the image for data storage and long distance transmission.

Mapping of COs and POs												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Η		L						Н			М
CO2				Н							L	
CO3		М								L		Н

#### LIST OF EXPERIMENTS

- 1. Digital image Fundamentals Sampling and quantization.
- 2. Image Enhancement Spatial filtering, Filtering in frequency domain
- 3. Removal of noise in medical images.
- 4. Image Transformation in spatial domain and frequency domain.
- 5. Edge detection and boundary tracing techniques.
- 6. Region based processing
- 7. Color image processing
- 8. Basic Morphological operations.
- 9. Image compressions.
- 10. Image segmentation by thresholding.

#### MINI PROJECTS

- 1. Applications to Biometric and security
- 2. Applications to Medical Images
- 3. Texture analysis with statistical properties
- 4. Boundary detection

#### PROJECT WORK

RMF18R400PDAIECT WARK	L	Т	Р	Credit					
DWIE10R4991 ROJECT WORK	0	0	0	10					
Pre-requisite: All Biomedical CoursesCourse Category: Program									
Course Type: Project work									

**Objective(s)** To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

#### Course Outcome(s)

Upon completion of the course, students will be able to

**CO1** On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

**CO2** The students in a group of 3 to 4 works on a topic will be approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor.

**CO3** The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.

CO4 A project report is required at the end of the .

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Н	Н	Η	Н	Н	Н	Н	Н	Н	Н	Н	Н

**CO5** The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

#### PROFESSIONAL ELECTIVES

BMF18D203	MEDICAL PHYSICS	L	Т	Р	Credit						
DIVIE10R203	WIEDICAL THI SICS	3	0	0	3						
Pre-requisite:	Nil Course Category	Course Category: Professional electives									
		Cou	rse T	ype: [	Гheory						

#### **Objective**(s)

- 1. To obtain knowledge of the normal structure and function of the body and its major organ systems with emphasis on content applicable to clinical diagnostic imaging and/or radiation oncology.
- 2. To understand radiation and radioactivity, its properties, units of measure, dosimetry measurement concepts and methods.

#### **Course Outcome(s)**

Upon completion of the course, the student should be able to:

- CO1 Interpret the non-ionizing radiation and its application in medical field
- CO2 Relate the utilization of ultrasound in medicine
- CO3 Illustrate the production of radioactive nucleotides
- CO4 Classify the different radiations and its interactions with matter
- CO5 Compare the effects of radiation and its units

	Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	М	М	Н										
CO2	М		L										
CO3	Μ	Н					L						
CO4	М												
CO5	L		L			Н	L					L	

#### UNIT I NON IONIZING RADIATION AND ITS MEDICAL APPLICATION

#### (9 HOURS)

Non-ionizing Electromagnetic Radiation: Overview of non-ionizing radiation effects-Low Frequency Effects- Higher frequency effects. Physics of light, Measurement of light and its unitlimits of vision and color vision an overview, Thermography– Application

#### UNIT II SOUND IN MEDICINE

Physics of sound, Normal sound levels –ultrasound fundamentals – Generation of ultrasound (Ultrasound Transducer) - Interaction of Ultrasound with matter; Cavitations, Reflection, Transmission-Scanning systems – Artefacts- Ultrasound- Doppler-Double Doppler shift-Clinical Applications

### UNIT III PRINCIPLES OF RADIOACTIVE NUCLIDES

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 radionuclide – Cyclotron produced Radionuclide- Reactor produced Radio- nuclide-fission and electron Capture reaction, radionuclide Generator-Technetium generator.

#### UNIT IV INTERACTION OF RADIATION WITH MATTER

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.

#### **UNIT V BASIC RADIATION QUANTITIES**

Introduction -exposure- Inverse square law-KERMA-Kerma and absorbed dose –stopping power - relationship between the dosimetric quantities - Bremsstrahlung radiation, Bragg's curve-concept of LD 50- Stochastic and Non-stochastic effects, Different radiation Unit, Roentgen, gray, Sievert.

### TEXT BOOKS

- John R Cameran , James G Skofronick "Medical Physics", 2<sup>nd</sup> edition, John-Wiley & Sons. 2012
- 2. W.J.Meredith and J.B. Massey "Fundamental Physics of Radiology" 3<sup>rd</sup> edition, Varghese Publishing house. 2013
- 3. Paul Davidovits "Physics in biology and Medicine" 4<sup>th</sup> edition, Academic Press Inc. 2012
- P.Uma Devi, A.Nagarathnam, B S SatishRao, "Introduction to Radiation Biology" B.I Chur Chill Livingstone pvt Ltd, 2000

## **REFERENCES**

- 1. "Webb's Physics of Medical Imaging, Second Edition", M.A.FLOWER, 2012.
- 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, 2000

BME18D204	ANALOC AND DICITAL COMMUNICATION	L	Т	Р	С
DIVILION204	ANALOG AND DIGITAL COMMUNICATION	3	0	0	3
Pre-requisite:	Nil Course Category Course Type: Th	y: Profe neory	ssiona	l elect	tives

**Objective**(s)

## (9 HOURS)

(9 HOURS)

To understand analog and digital communication techniques and to gain knowledge on multiuser radio communication.

#### **Course Objectives**

The student should be able to

- 1. Apply analog and digital communication techniques.
- 2. Learn data and pulse communication techniques.
- 3. Learn digital modulation and transmission techniques.
- Analyze source and error control coding. 4.
- 5. Gain knowledge on multi-user radio communication.

Mapp	Mapping of COs and Pos											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	М				L							
CO2					L							
CO3	L				L							
CO4	Н				L							
CO5					L							

## **UNIT - I ANALOG MODULATION**

#### Amplitude Modulation - AM, DSBSC, SSBSC, VSB - PSD, modulators and demodulators -Angle modulation – PM and FM – PSD, modulators and demodulators – Super heterodyne receivers

#### **UNIT - II PULSE MODULATION**

Low pass sampling theorem – Quantisation – PAM – Line coding – PCM, DPCM, DM, ADPCM and ADM, Channel Vocoder - Time Division Multiplexing, Frequency Division Multiplexing 57 **UNIT - III DIGITAL MODULATION AND TRANSMISSION TECHNIQUES** 9 Hours Phase shift keying - BPSK, DPSK, QPSK - Principles of M-ary signaling M-ary PSK & QAM -Comparison, ISI - Pulse shaping - Duo binary encoding - Cosine filters - Eye pattern, equalizers

#### **UNIT - IV INFORMATION THEORY AND CODING**

Measure of information - Entropy - Source coding theorem - Shannon-Fano coding, Huffman Coding, LZ Coding - Channel capacity - Shannon-Hartley law - Shannon's limit - Error control codes - Cyclic codes, Syndrome calculation - Convolutional Coding, Sequential and Viterbi decoding

**UNIT – V SPREAD SPECTRUM AND MULTIPLE ACCESS** 9 Hours PN sequences - properties - m-sequence - DSSS - Processing gain, Jamming - FHSS -

Synchronization and tracking – Multiple Access – FDMA, TDMA, CDMA.

#### **TEXT BOOKS**

1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007

2. S. Haykin "Digital Communications" John Wiley 2005

#### REFERENCES

9 Hours

## 9 Hours

9 Hours

1. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3/e, Oxford University Press, 2007

2. H P Hsu, Schaum Outline Series - "Analog and Digital Communications" TMH 2006

3. B.Sklar, Digital Communications Fundamentals and Applications" 2/e Pearson Education 2007

RME19D205BIOMATEDIALS AND ADTIFICIAL ODCANS	L	Т	Р	Credit
DWEIOR205DIOWATERIALS AND ARTIFICIAL ORGANS	3	0	0	3
Pre-requisite: NILCourse Category: Professional electives				

Course Type: Theory

**Objective(s)** To understand and analyze the different types of Biomaterials and design new materials and organs to meet the medical needs

#### Course Outcome(s)

Upon completion of this course, the students will be able to

CO1 Experiment with the classes of materials that can be used for medical applications

**CO2** Illustrate the response of human body towards the application of biomaterial and the characterization methodologies for biomaterials

CO3 Apply the Biomaterials as drug delivery systems and in ophthalmology

CO4 Perform combination of materials that could be used as a tissue replacement implant

#### CO5 Understand and design artificial organs

Mapp	Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	L				L								
CO2	L												
CO3		Н	Н		М								
CO4		Н	Н								L		
CO5		Н	Н		М								

#### UNIT I CLASSES OF MATERIALS USED IN MEDICINE

(9 HOURS)

Classification of Biomaterials: Metals and alloys; stainless steel, cobalt based alloys, titanium based materials – ceramics – bioinert ceramics – carbon, alumina, zircona and titania – bioactive ceramics – bioactive glass and glass ceramics, calcium phosphate ceramics – polymers – PMMA bone cement, articulating component – UHMWPE – composites, matrix and filter components, Surface properties and Bulk mechanical properties.

#### UNIT II BIOLOGICAL PERFORMANCE OF MATERIALS

#### (9 HOURS)

Biocompatibility-Tissue Compatibility – material response: – deformation and failure – friction and wear – Host response – Inflammatory process – capsule formation – coagulation and

hemolysis – approach to thromboresistant material development –carcinogenesis. Biocompatibility testing:-in vitro and in vivo studies of biocompatibility.

#### UNIT III OPHTHALMOLOGIC APPLICATIONS AND DRUG DELIVERY SYSTEMS (9 HOURS)

Materials for ophthalmology – contact lens and intraocular lens materials – Corneal Implants-Implants for Glaucoma-Implants for Retinal Detachment surgery- drug delivery systems:-Diffusion Controlled-Water penetration controlled –Chemically Controlled-Regulated Systems

#### UNIT IV TISSUE REPLACEMENT IMPLANTS

Small intestinal submucosa and other decellularized matrix biomaterials for tissue repair. Soft tissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, Dental Implants, Pancreas replacement.

#### **UNIT V ARTIFICIAL ORGANS**

Artificial blood, artificial skin, Artificial Heart, Prosthetic Cardiac Valves, Artificial lung (oxygenator), Artificial Kidney (Dialyzer membrane)

#### TEXT BOOKS

1. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science "An Introduction to Material in Medicine" Third Edition, 2013.

2. Jonathan Black, Biological Performance of materials, Fundamentals of Biocompatibility, Marcel Dekker Inc., 4<sup>th</sup> edition New York, 2005

3.Joon Park, R S Lakes, Biomaterials: An Introduction, Springer science and Business Media, 2007

4. Sujatha.V..Bhat, Biomaterials, II Edition Alpha Science 2005

#### **REFERENCES**

1. Amit Bandhyopadhya, Susmita Bose, Characterization of Biomaterials, Newnes, 2013

RME18D206HOSDITAL MANACEMENT		L	Т	Р	Credit			
DWEIGK200105111AL WANAGEWENT		3	0	0	3			
Pre-requisite: Nil	Course Category: Professional electives							
	Course Type: Theory							

**Objective(s)** Understand the principles, practices and areas of application in Hospital management

#### **Course Outcome(s)**

- **CO1** To understand the principles, staffing and marketing processes, discussing their significance.
- CO2 To manage their role in effective and efficient management of health care organizations.
- CO3 To analyse the various regulations and standards to be followed in hospitals for safety.

#### (9 HOURS)

- CO4 To evaluate various aspects of equipment maintenance.
- **CO5** To apply the aspects of managing the hospital in terms of staff, marketing and the use of computers.

Mapp	Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	Μ					L					Μ		
CO2									Н	Н	Н		
CO3					М	Н		Н			L		
CO4	L					L					М		
CO5									Н	Η	L		

#### UNIT I HEALTH SYSTEM

(9 HOURS)

Health organisation of the country, the state, the cities and the region, Health Financing System, Organisation of Technical Section.

#### UNIT II HOSPITAL ORGANISATION AND MANAGEMENT (9 HOURS)

Management of Hospital organisation, Nursing section Medical Sector, Central Services, Technical Department, Definition and Practice of Management by Objective, Transactional Analysis Human relation in Hospital, Importance to Team Work, Legal aspect in Hospital Management.

#### UNIT III REGULATORY REQUIREMENT AND HEAI TH CARE CODES

#### (9 HOURS)

FDA Regulation, joint commission of Accreditation for Hospitals, National Fire Protection Association Standard, IRPC.

#### UNIT IV EQUIPMENT MAINTENANCE MANAGEMENT (9 HOURS)

Organising Maintenance Operations, Paper Work Control, Maintenance Job, Planning Maintenance Work Measurement and Standards, Preventive Maintenance, Maintenance Budgeting and Forecasting, Maintenance Training, Contract Mainframe.

#### UNIT V TRAINED TECHNICAL PERSONNEL (9 HOURS)

Function of Clinical Engineer, Role to be performed in Hospital, Man power Market, Professional Registration, Structure in hospital.

#### **REFERENCE BOOKS**

- 1. Cesar A. Caceres and Albert Zara, The practice of Clinical Engineering, Academic Press, 1977.
- 2. Webster, J.G. and Albert M. Cook, Clinical Engineering Principles and Practices, Prentice Hall Inc. Englewood Cliffs, 1979.
- 3. Antony Kelly, Maintenance planning and control, Butterworths London, 1984.
- 4. Hans Pfeiff, Vera Dammann (Ed.) Hospital Engineering in Developing Countries, Z report Eschborn, 1986.

5. Jacob Kline, Handbook of Bio Medical Engineering, Academic Press, San Diego 1988.

6. R.C. Goyal, Handbook of Hospital Personal Management, Prentice Hall of India, 1993.

RME18D302DADIOLOCICAL IMACINC SYSTEM	L	Т	Р	Credit				
DVIE10K302KADIOLOGICAL INIAGING 5151EN	3	0	0	3				
Pre-requisite: BME18R252	Course Category: Professional electives							

Course Type: Theory

**Objective**(s) To understand various types of radiological sources, equipmentscontruction and working with precaution measures to be taken.

#### Course Outcome(s)

CO1 Learn different types of radio diagnostic techniques

CO2 Understand generation of x-rays and its uses in imaging.

CO3 Know techniques used for visualizing different sections of the body

- CO4 Acquire knowledge in various nuclear source and measuring devices
- **CO5** Learn radiation therapy methodologies and the radiation safety

	Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	М												
CO2		L			Н								
CO3			Н										
CO4	М			L									
CO5						Н	М	Н					

#### UNIT I MEDICAL X-RAY EQUIPMENT

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

#### UNIT II COMPUTED TOMOGRAPHY

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors-Viewing systems- spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques- back projection and iterative method.

#### UNIT III MAGNETIC RESONANCE IMAGING

## (9 HOURS)

#### 63

## (9 HOURS)

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), shim coils, Electronic components, Fmri.

#### UNIT IV NUCLEAR MEDICINE SYSTEM

#### (9 HOURS)

Radio Isotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors –gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera- Principle of operation, collimator, photo multiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET.

#### UNIT V RADIATION THERAPY AND RADIATION SAFETY (9 HOURS)

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.

#### 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.

BME18D303	MEDICAL OPTICS AND LASEPS	L	Т	Р	Credit						
DIVILIONJUJ	MEDICAL OF TICS AND LASERS	3	0	0	3						
Pre-requisite:	Course Category: Professional electives										
	Course Type: Theory										

**Objective(s)** To acquire adequate knowledge in physics of light in biological tissues and its application in diagnostic and therapeutic applications.

#### **Course Outcome(s)**

Upon completion of the course, the students should be able to

- **CO1** Be familiar with property of light in tissues
- CO2 Acquire knowledge in source and detectors of light.

- **CO3** Application of light in diagnostic practices.
- CO4 Understand the concept of LASER in therapeutic applications.
- **CO5** Be exposed to Optical Holography

#### Mapping of COs and Pos

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	М				М							
CO2			L									
CO3		Η			L							
CO4												
CO5				Η								

#### **UNIT-IOPTICAL PROPERTIES OF THE TISSUES(9 HOURS)**

Refraction, scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, optothermal interaction, fluorescence, speckles.

#### **INSTRUMENTATION IN PHOTONICS** UNIT II

Instrumentation for absorption, scattering and emission measurements, excitation light sources - high pressure arc lamp, solid state LEDs, optical filters, polarisers, time resolved and phase resolved detectors.

#### **UNIT III APPLICATIONS OF LASERS**

Laser in tissue welding, lasers in dermatology, lasers in ophthalmology, otolaryngology, urology. LASERS in surgery.

#### **UNIT IV OPTICAL HOLOGRAPHY**

Wave fronts, interference patterns, principle of hologram, optical hologram, applications.

#### **UNIT V SPECIAL TECHNIQUES**

Near field imaging of biological structures, in-vitro clinical diagnostic, fluorescent spectroscopy, photodynamic therapy.

#### **TEXT BOOKS**

1. Leon Goldman, M.D., &R.James Rockwell, Jr., "Lasers in Medicine", Gordon and Breach, Science Publishers Inc., 1975.

2. Abraham Katzir, "Lasers and Optical Fibers in Medicine", Academic Press Edition, 1998.

#### REFERENCES

- 1. Tuan Vo Dirh, "Biomedical Photonics Handbook", CRC Press, Bocaraton, 2003 (Unit I -III, V)
- 2. Glasser, O., "Medical Physics -- Vol 1, 2, 3 "Adam HilgarBrustol Inc, 1987.
- **3.** G.David Baxter "Therapeutic Lasers Theory and practice", Churchill Livingstone Publications Edition- 2001.

#### (9 HOURS)

#### (9 HOURS)

(9 HOURS)

Pre-requisite: Nil

Course Category: Professional electives

3

0

0

Course Type: Theory

**Objective(s)** To discuss the various aspects of informatics applied in health industry so that quality of health care is improved.

#### **Course Outcome(s)**

- CO1 To understand the system of information managed in the hospital.
- CO2 To demonstrate the application of softwares employed in medical data management.
- CO3 To examine medical imaging data with an assist of computers.
- CO4 To understand the concept of maintaining digital patient records.

**CO5** To acquire knowledge in delivering instructions in medicine using computers.

Mapp	ping of	COs ai	nd Pos									
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L											Н
CO2					Н		Μ				Н	L
CO3		М										М
CO4				L	М							Н
CO5								Μ				Η

#### UNIT I HOSPITAL INFORMATION SYSTEM

#### (9 HOURS)

3

Introduction –Historical review of the development of computers and informatics –Foundation ontology – use of internet in medicine –Internet vs online services-computer based medical information retrieval.

#### UNIT II COMPUTERISED PATIENT DATABASE MANAGEMENT

#### (9 HOURS)

Data base approach -Automated clinical laboratories – automated method in hematology – chromosome analysis by computer –computerised cytology and histology- Automatic scanning for cervical cancer –computer assisted semen analysis-Radio immuno assays-Intelligent laboratory information system- computerized ECG-computer aided analysis of ECG-computerised EEG and EMG. Computer assisted medical imaging-ultrasound –CT Radiation therapy planning-NMR.

# UNIT III COMPUTER ASSISTED MEDICAL IMAGING AND DECISION MAKING (9 HOURS)

Computer Assisted Medical Decision Making-Model of CMD-Approaches-Decision Support Systems Algorithms –Analysis –CBR-Production Rule Systems-Cognitive Models-Somantic Networks –Decision Analysis in Clinical Medicine –Hospital Information System-Functional Capabilities –Need-Security-Cost Effectiveness. Clinical Information System –Benefits – Sources Of Data-Modes Of Decision –CIS in Obestrics and Gynecology-Clinical Decision Support.

#### UNIT IV COMPUTERISED PATIENT RECORD

Computerised Patient Record –Introduction-History Taking By Computer-Dialogue With The Computer - Computerised Prescriptions For Patients-Introduction-Adverse Drug Reactions-

Computer Assisted Patient Education And Health Care Information –Introduction –Health Online –Electronic Communication With Patients-Importance Of Behaviour Modification – Patient Self Management Education-Computers In Case Of Critically III Patients- Introduction – Cognitive System, Engineering –Automated Computer Assisted Fluid And Metabolic Balance – Pulmonary Function Evaluation-Computer Aids For The Handicapped-Computer Assisted Surgery.

#### UNIT V COMPUTER ASSISTED INSTRUCTION IN MEDICINE(9 HOURS)

Computer Assisted Drug Discovery And Development, Molecular Modelling By Computer-Computational Representation Of Molecules-Modelling GPCRS-Pharmacophores-New Drugs For Cancer-0 from Gene To Screen –Combinational Chemistry-Metabolomics-Knowledge Based Drug Discovery-Pharmaco Metabolomics Role Of PET And SPECT In Drug Discovery. Computer Assisted Instruction In Medicine.

#### TEXT BOOK

1. R. D. Lee, Computers in Medicine, Tata McGraw Hill Publishing Company Limited, New Delhi, 1993.

#### **REFERENCE BOOKS**

1. Harold Sackamn, Biomedical Information Technology, Academic Press, New York.

2. S.K.Chachan, PC Organisation, S.K. Kataria and Sons, Delhi 2000

<b>BME18D305</b>	DESIGN OF BIOMEDICAL I	NGTDIMENTS	L	Т	Р	Credit
DWILTOKJUJ	DESIGN OF BIOMEDICAL I		3	0	0	3
Pre-requisite:	- BME18R252	Course Category	: Pro	fessio	nal E	lectives

Course Type: Theory

**Objective(s)** To introduce the students to the application of biomedical instrumentation and to familiarize the students with the analysis and design of different instrument to measure biosignals. It also includes brief study of different medical instrument and their use in physiological measurements

#### **Course Outcome(s)**

Up on completion of the course, the students will be able to

- **CO1** Understand the basic building blocks of Medical instrumentation system.
- CO 2 Learn several signals and design parameters of ECG, EEG, EMG, ERG and MEG.
- **CO 3** Understand the various blood flow measurement systems.
- CO 4 Design a respiratory system model and various techniques to measure air flow.
- CO 5 Understand different assisting and therapeutic equipment's.

#### UNIT I - BASIC CONCEPTS OF MEDICAL INSTRUMENTATION(9 HOURS)

General Medical Instrumentation System, Medical Measurement Constraints, Alternative Operation modes, Classification of Biomedical Instruments, Interfering and Modifying inputs, Compensation techniques, Design Criteria.

(9 HOURS)

UNIT II - THE ORIGIN OF BIOPOTENTIAL

Electrical Activity of Excitable Cells, Volume Conductor fields, Functional organization of the peripheral nervous system, Electroneurogram, Electromyogram, Electrocardiogram, Electrocencephalogram, Magnetocepahalogram.

#### UNIT III - MEASUREMENT OF BLOOD PRESSURE, FLOW AND VOLUME

#### (9 HOURS)

Direct measurement, Harmonic analysis of Blood Pressure, Indicator Dilution method that uses continuous Infusion and rapid injection, Electromagnetic flowmeters, Ultrasonic flowmeters, Chamber Plethysmography, electrical Impedance Plethysmography, Photoplethysmography.

#### UNIT IV - MEASUREMENT OF RESPIRATORY SYSTEM (9 HOURS)

Modelling the respiratory system, measurement of pressure, measurement of gas flow, lung volume, respiratory plethysmography.

#### UNIT V - THERAPEUTIC AND PROSTHETIC DEVICE (9 HOURS)

Cardiac Pacemakers and other Electric Simulators, Defibrillators and Cardioverters, Mechanical Cardiovascular orthotic and prosthetic devices, haemodialysis, Lithotripsy, Ventilators, Infant Incubators, Surgical Instruments

#### TEXT BOOKS

1.J.Webster, "Medical Instrumentation: application and Design", John Wiley & Sons; 4th Revised edition 2009

#### **REFERENCES**

- 1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007
- 2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.
- 3. L.A Geddas and L.E.Baker "Principles of Applied Biomedical Instrumentation" 2004.
- 4. John G. Webster, "Bioinstrumentation", John Willey and sons, New York, 2004.
- 5. Myer Kutz "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill Publisher, 2003.

BME18R306	TELEMEDICINE	L	Т	Р	С
			0	0	3
Pre-requisite: Nil	Course C	ategory	Profess	ional ele	ectives
Course Type: Theory					

#### **Objective(s)** Apply telemetry in healthcare

#### Course Outcome(s)

- CO1 Apply multimedia technologies in telemedicine
- CO2 Understand telemedical technology.
- CO3 Learn the key principles for telemedicine and health.

CO4 Explain Protocols behind encryption techniques for secure transmission of data.

Mapping of COs and Pos												
СО	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L											
CO2					L					М		
CO3		Η				Η					Н	
CO4												
CO5				Μ								L

CO5 Know telemedical standards, mobile telemedicine and it applications

#### UNIT I TELEMEDICINE AND HEALTH

History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Telehealth, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

#### UNIT II TELEMEDICAL TECHNOLOGY

Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN,POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Micro wave, Modulation techniques, Types of Antenna, Integration and operational issues, Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication. Mobile hand held devices and mobile communication. Internet technology and telemedicine using world wide web (www). Video and audio conferencing. Clinical data – local and centralized.

#### UNIT III TELEMEDICAL STANDARDS

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-time Telemedicine integrating doctors / Hospitals, Clinical laboratory data, Radiological data, and other clinically significant biomedical data, Administration of centralized medical data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

#### UNIT IV MOBILE TELEMEDICINE

Tele radiology: Definition, Basic parts of teleradiology system: Image Acquisition system Display system, Tele pathology, multimedia databases, color images of sufficient resolution, Dynamic range, spatial resolution, compression methods, Interactive control of color, Medical information storage and management for telemedicine- patient information medical history, test reports, medical images diagnosis and treatment. Hospital information system - Doctors, paramedics, facilities available. Pharmaceutical information system.

#### UNIT V TELEMEDICAL APPLICATIONS

Telemedicine access to health care services – health education and self care. Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability., Telemedicine access to health care services – health education and self care, Business aspects - Project planning and costing, Usage of telemedicine.

#### TEXT BOOK:

1. Norris, A.C. "Essentials of Telemedicine and Telecare", Wiley, 2002

#### **REFERENCES:**

- 1. Wootton, R., Craig, J., Patterson, V. (Eds.), "Introduction to Telemedicine. Royal Society of Medicine" Press Ltd, Taylor & Francis 2006
- 2. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), "Public Health Informatics and Information Systems", Springer, 2003.
- 3. Ferrer-Roca, O., Sosa Iudicissa, M. (Eds.), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54, 2002.
- 4. Simpson, W. Video over IP. A practical guide to technology and applications. Focal Press Elsevier, 2006.
- 5. Bemmel, J.H. van, Musen, M.A. (Eds.) Handbook of Medical Informatics. Heidelberg, Germany: Springer, 1997.
- 6. Mohan Bansal, "Medical Informatics", Tata McGraw-Hill, 2004.

RME19D307VIDTUAL DEALITV		L	Τ	Р	Credit
DWEIOK507 VIKTUAL KEALITT		3	0	0	3
Pre-requisite: BME18R351	Course Categor	v: Pr	ofessi	ional	Elective

Course Type: Theory

**Objective(s)** Design a system or process to meet given specifications with realistic engineering constraints.

#### **Course Outcome(s)**

- **CO1** Explore the potential of a virtual world for delivering application.
- **CO2** Determine possible instructional designs.
- **CO3** Understand the limitations.
- CO4 Applying software in virtual reality.
- CO5 Understand the barriers, solutions, and costs associated, including required training.

Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Μ											
CO2												
CO3		Н										
CO4					М							
CO5												

#### **UNIT I INTRODUCTION**

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): Threedimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.

#### **UNIT II MODELING**

Geometric modelling - kinematics modelling- physical modelling - behaviour modelling model management.

#### **UNIT III HUMAN FACTORS**

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

#### **UNIT IV VR PROGRAMMING**

Introducing Java 3D-loading and manipulating external models-using a lathe to make shapes. 3D Sprites- animated 3D sprites-particle systems.

#### UNIT V **APPLICATIONS**

Medical applications-military applications-robotics applications- Advanced Real time Tracking-other applications- games, movies, simulations, therapy.

#### **TEXT BOOKS**

C. Burdea& Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, 1. John Wiley & Sons, Inc., 2008.

Andrew Davison, "Killer Game Programming in Java", Oreilly SPD, 2005. 2.

#### REFERENCES

- 1. William R.Sherman, Alan Craig, "Understanding Virtual Reality, interface, Application and Design", Elsevier, Morgan Kaufmann, 2002.
- 2. Bill Fleming,"3D Modeling and surfacing", Elsevier, Morgan Kauffman, latest edition
- 3. David H.Eberly, "3D Game Engine Design Practical Approach to Real-Time Computer Graphics", Elsevier, 2007.
- 4. John Vince, "Virtual Reality Systems", Pearson Education, 2007.

<b>BME18D308</b>	BIOMETDIC SVSTEMS		L	Т	Р	С
DWILTONSUO	<b>DIOMETRIC STSTEMS</b>		3	0	0	3
Pre-requisite: BM	E18R272 Cours	se Cate	gory: F	Profession	onal ele	ctives
Course Type: The	ry					

Objective(s) To understand the existing biometric systems and to develop novel Biometric systems utilizing unique features of the human body

#### **Course Outcome(s)**

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

- CO1 Understand the concept of Biometrics and its applications
- CO<sub>2</sub> Illustrate the various methodologies involved in fingerprint technology

#### (9 HOURS)

(9 HOURS)

(9 HOURS)

### (9 HOURS)

- CO3 Develop techniques for face recognition and hand geometry biometrics
- CO4 Demonstrate the multimodal biometrics and the methods for evaluating the performance

		-							•			
Mapp	oing of <b>(</b>	COs and	d POs									
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L											
CO2				Μ								
CO3		Μ										
CO4		Η								L		
CO5			Μ		Н						L	Н

CO5 Distinguish the authentication mechanism of the biometric systems

#### **UNIT I INTRODUCTION TO BIOMETRICS**

Introduction and back ground – biometric technologies – passive biometrics – active biometrics -Biometric systems – Enrolment – templates – algorithm – verification – Biometric applications – biometric characteristics- Authentication technologies –Need for strong authentication – Protecting privacy and biometrics and policy – Biometric applications – biometric characteristics

#### UNIT II FINGERPRINT TECHNOLOGY

History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques - fingerprint quality assessment - computer enhancement and modelling of fingerprint images - fingerprint enhancement - Feature extraction - fingerprint classification - fingerprint matching

#### UNIT III FACE RECOGNITION AND HAND GEOMETRY

Introduction to face recognition, Neural networks for face recognition – face recognition from correspondence maps – Hand geometry – scanning – Feature Extraction - Adaptive Classifiers - Visual-Based Feature Extraction and Pattern Classification - feature extraction – types of algorithm –Biometric fusion.

#### UNIT IV MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION

Voice Scan – physiological biometrics –Behavioral Biometrics - Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy –training and adaptability – examples of multimodal biometric systems – Performance evaluation- Statistical Measures of Biometrics – FAR – FRR – FTE – EER – Memory requirement and allocation.

#### UNIT V BIOMETRIC AUTHENTICATION

Introduction - Biometric Authentication Methods - Biometric Authentication Systems – Biometric authentication by fingerprint -Biometric Authentication by Face Recognition. -. Expectation- Maximization theory - Support Vector Machines. Biometric authentication by fingerprint –biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication
# TEXT BOOKS:

- 1. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, "Biometric Systems, Technology Design and Performance Evaluation", Springer, 2005 (Units I, II, III & IV)
- 2. S.Y. Kung, S.H. Lin, M.W.Mak, "Biometric Authentication: A Machine Learning Approach"Prentice Hall, 2005(Unit V)

# **<u>REFERENCES</u>**:

- 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. Arun A. Ross, Karthik Nanda Kumar, Anil K. Jain, "Handbook of Multibiometrics", Springer, 2006.

		L	Т	Р	С
BME18R309	NEURAL NETWORK	3	0	0	3
Pre-requisite: N	il Co	urse Catego	ory: profe	ssional ele	ctives
Course Type: T	neory				

# **OBJECTIVES:**

- 1. The course will introduce the basic neural network architectures and learning algorithms, for applications in pattern recognition, image processing, and computer vision.
- 2. The course also covers the fundamentals of pattern recognition and its application.
- 3. The major focus of this course will be on the use of Pattern and Neural Classifiers for classification applications

# Course Outcome(s)

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

- **CO1** Understand the basic concepts of artificial neural networks (ANN)
- CO2 Familiarize about various ANN models
- CO3 Obtain knowledge about the self organizing maps and competitive networks
- CO4 Design and apply different types of pattern classification techniques
- **CO5** Analyze about the application of AI in medical field and use feature extraction based on clustering.

Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Μ											
CO2	Μ			М								
CO3	М			L								

CO4	М			Η								
CO5	М			Н								
UNIT	I INTR	RODUC	TION	AND S	IMPLE	E NEUI	RAL NI	ET			(9 H	ours)
Eleme	ntary r	neuroph	ysiolog	y and	biolog	gical no	eural r	network	- Artif	icial ne	eural ne	etwork-
Archit	ecture, l	oiases a	nd thres	sholds, I	Hebb ne	et, Perce	eptron,	Adaline	and Ma	adaline.		
UNIT	II BAC	CK PRO	<b>DPAGA</b>	TION	AND A	SSOC	IATIVI	E MEN	IORY		(9 H	ours)
Back 1	propaga	tion net	twork, g	generali	ized de	lta rule,	, Bidire	ctional	Associa	ative me	mory H	opfield
Netwo	rk											
UNIT	III NE	URAL	NETW	ORKS	BASE	D ON C	COMPE	ETITIC	N		(9 Ho	ours)
Kohon	en Self	organiz	ing ma	p, Learr	ning Ve	ctor Qu	antisati	on, Cou	nter Pro	pagatio	n netwoi	·k.
UNIT	IV INT	RODU	OITO	N AND	SUPE	RVISE	D LEA	RNING	ſ		(9 Ho	ours)
Overvi	iew of 1	Pattern	recogni	tion, T	ypes of	Pattern	n recog	nition,	Parame	tric and	Nonpara	ametric
approa	ich, Ba	yesian	classifi	ier, Di	scrimin	ant fur	nction,	non p	arametr	ic dens	ity estin	mation,
histog	rams, ke	ernels, v	vindow	estimat	ors, k-	nearest	neighbo	or classi	fier, est	imation	of error	rates.
UNIT	V UNS	UPER	VISED	LEAR	NING A	AND C	LUSTE	ERING	ANAL	YSIS	(9 Ho	ours)
Unsup	ervised	learnin	ig- Hiei	rarchial	cluster	ring- Si	ingle-liı	nkage A	Algorith	m, Con	nplete –	linkage
Algori	thm, A	verage-	linkage	algori	thm an	d War	d''s me	thod. F	Partition	al clust	ering- F	Forgy"'s
Algori	thm, k-ı	neans a	lgorithr	n and Is	sodata A	Algorith	m				-	
TEXT	BOOK	KS	-			-						

- 1. DudaR.O, Hart P.G, "Pattern Classification and scene analysis", Wiley Edition 2000
- 2. Earl Gose, Richard Johnsonbaugh Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Pvt Ltd., New Delhi, 1999
- 3. Hagan, Demuth and Beale, "Neural network design", Vikas Publishing House Pvt Ltd., New Delhi, 2002
- 4. Freeman J.A., and Skapura B.M, "Neural networks, algorithms, applications and programming techniques", Addison- Wesley, 2003.

# **REFERENCES**

- 1. Robert Schalkoff, "Pattern recognition, Statistical, Structural and neural approaches" John Wiley and Sons(Asia) Pvt Ltd., Singapore, 2005.
- 2. Laurene Fausett, "Fundamentals of neural networks- Architectures, algorithms and applications", Prentice Hall, 1994.

RME18D310CLINICAL ENCINEEDINC	Ι	L	Т	Р	Credit			
DMEIORSIUCLINICAL ENGINEERING	3	3	0	0	3			
Pre-requisite: Nil	Course Category: Professional electives							
Course Type: Theory								

**Objective(s)** To perform the role as a Biomedical engineer in the hospital understanding all the modules involved in hospitals.

# **Course Outcome(s)**

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

- Classify the architecture and types of hospitals **CO1**
- **CO2** Understand how an electrical system should be in a hospital
- CO3 Understand the air conditioning and gas systems
- CO4 Know about the importance of Biomedical Engineer

**CO5** Attain knowledge about the hospital information.

Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						Н						
CO2		Н										
CO3								М				
CO4				Н	Н							
CO5										Н		

**UNIT I CLASSIFICATION OF HOSPITAL & ARCHITECTURE** (9 HOURS)

General hospital, specialized hospital, primary health care – their role and functions. Aspects of hospital services - inpatient, outpatient and emergency. Location and environment of hospital, Hierarchy of medical and paramedical staff & their functions and responsibilities. Modern Hospital Architecture- space in a hospital building, design of ward, intensive care units, air conditioning, plumbing & sanitation, gas supply, waste disposal, cleaning, dietary, sterilizing, laundry, storage and operation theatre systems, Radiology, Central labs, Blood banks, OPD, Causality, etc.

# **UNIT II ELECTRICAL POWER SYSTEMS IN HOSPITALS**

Safety of electrical systems, Protective systems - interference of patient's protection grounding. Design of sub stations, breakers, Surge protectors, EMI filters, voltage stabilizers, generator sets and UPS. Uninterrupted power supply for ICU and computerized monitoring units. Specification & estimation for hospital wiring - small case study.

# **UNIT III AIR CONDITIONING & GAS SUPPLY SYSTEMS**

Air conditioning and refrigeration systems for small and large areas. Air changes, filtering and sterility. Deodorization, disinfection, dehumidification and cryogenic systems. Centralized supply of air, oxygen, nitrous oxide & vacuum - Principle of production of liquid oxygen. Management lifts fire fightingequipments.

# **UNIT IV HOSPITAL ENGINEERING & MANAGEMENT**

Definition of biomedical Engineering, clinical engineering & hospital engineering. Importance of BME department - servicing and maintenance, testing, acceptance & maintenance protocols, Computerized preventive maintenance planning, MROs. Training of men for medical equipments preventive and periodical maintenance procedures. Preparation of estimates, specifications, tender details etc. Importance of ISO 9000 Certificates -Obtaining ISO certificates in hospitals. Proposed protocols.

# **UNIT V HOSPITAL INFORMATION SYSTEM**

# (9 HOURS)

# (9 HOURS)

(9 HOURS)

Role of database in HIS. Need of Networking in HIS. Overview of Networking, topologies and its configuration. Structuring medical records to carry out functions like admissions, discharges, treatment history etc. Computerization in pharmacy & billing. Automated clinical laboratory systems & radiology information system.

# TEXT BOOK

1. Harold E. Smalley, "Hospital Management Engineering – A guide to the improvement of hospital management system", PHI. Latest Edition

# **REFERENCES**

- 1. Sharma, Essentials for Hospital Support Services and Physical Infrastructure, 1/e, Jaypee Medical Publishers 2003
- 2. Hospital Engineering And Facilities Management 2007 Report, Fifth official report of the International Federation of Hospital Engineering (IFHE), January 2007
- 3. Gupta, Kant, Chandrashekhar, Satpathy, Modern Trends in Planning and Designing of Hospitals Principles and Practice with CD-ROM, Jaypee Medical publishers, 1/e, 2007
- 4. Sakharkar, Principles of Hospital Administration and Planning, Jaypee Medical publishers 1/e, Reprint 2004

RME18D311RIOFI LUDS AND DVNAMICS	L	Т	Р	Credit
DWIE16K511DIOF LUIDS AND DINAMICS	3	0	0	3
Pre-requisite: BME18R351Course Category: Professional Elective				

# Course Type: Theory

# **Objective**(s)

- An understanding on the physiology and anatomy of studied systems.
- A capability to analyse cardiac, respiratory, soft tissue and orthopedic mechanics.

# Course Outcome(s)

- **CO1** To understand the concept of mechanics of bio-fluids.
- **CO2** To study the nature of blood flow in different vessels.
- CO3 To understand mechanical activity of heart.
- CO4 To understand mechanical activity of soft tissues.
- **CO5** To understand mechanical activity of bones and joints.

Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		L										
CO2			М		Н							
CO3	Μ					Н						
CO4		Н		Н								
CO5	Н											

# **UNIT I BIO-FLUID MECHANICS**

(9 HOURS)

Newton's laws, Stress, Strain, Elasticity, Hooks-law, viscosity, Newtonian fluid, Non-Newtonian

fluid, Viscoelastic fluids, vascular tree, Relationship between diameter, velocity and pressure of blood flow, Resistance against flow. Bioviscoelastic fluid: Viscoelasticity - Viscoelastic models, Maxwell, Voigt and Kelvin Models, Response to Harmonic variation, Use of viscoelastic models, Bio- Viscoelastic fluids: Protoplasm, Mucus, Saliva, Synovial fluids.

# **UNIT IIFLOW PROPERTIES OF BLOOD**

Physical, Chemical and Rheological properties of blood. Apparent and relative viscosity, Blood viscosity variation: Effect of shear rate, hematocrit, temperature, protein contents of blood. Casson's equation, Problems associated with extracorporeal blood flow. Rheology of Blood In Microvessels: Fahraeus - Lindquist effect and inverse effect, distribution of suspended particles in a narrow rigid tube. Nature of red blood cells in tightly fitting tubes, hematocrit in very narrow tube:

### **UNIT III CARDIAC MECHANICS** (9 HOURS)

Cardiovascular system. Mechanical properties of blood vessels: arteries, arterioles, capillaries and veins. Blood flow: Laminar and Turbulent, Physics of cardiovascular diseases, Prosthetic heart valves and replacements. Respiratory Mechanics: Alveoli mechanics, Interaction of Blood and Lung P-V curve of Lung: Breathing mechanism, Airway resistance, Physics of Lung diseases.

# **UNIT IV SOFT TISSUE MECHANICS**

Pseudo elasticity, non-linear stress-strain relationship, Viscoelasticity, Structure, function and mechanical properties of skin, ligaments and tendons.

# **UNIT V ORTHOPEDIC MECHANICS**

Mechanical properties of cartilage, diffusion properties of Articular cartilage, mechanical properties of bone, kinetics and kinematics of joints, lubrication of joints.

# **TEXT BOOK**

1. Y.C Fung, "Biomechanics- Mechanical properties of living tissues", 2nd Edition, Springer-Verlag, 1993.

# REFERENCES

- 1. David A. Rubenstein, Weiyin, Mary D. Frame, "Biofluid Mechanics- An Introduction to fluid
- 2. Mechanics, Macrocirculation and Microcirculation", Springer, 2013.
- 3. Silver Frederick H. Biomaterials, Medical Devices & Tissue Engineering: Chapman &Hall,London, 1994
- 4. Nihanthozkai, D.A Mc Donald ,"Biomechanics, Blood flow in arteries", Edward Arnold ltd, 1998.
- 5. D.O Cooney, Biomedical Engineering Principles. Marcel Dekker, INC New York. 1976.

BME18R312	EMBEDDED SYSTEMS IN MEDICINE	L	Т	Р	С
		3	0	0	3
Pre-requisite:	Nil Course Category: Profess	sional	electi	ve	
Course Type: 7	Гheory				

# (9 HOURS)

(9 HOURS)

**Objective(s)** To introduce students to the modern embedded systems and to show how to understand and program such systems using a concrete platform built around.

# Course Outcome(s)

- CO1 Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems.
- CO2 To acquire knowledge in various processors employed in embedded systems
- CO3 Implementation of concurrent process and data flow models.
- CO4 Design real time embedded systems using the concepts of RTOS
- CO5 Apply the concept of embedded system in various medical applications.

Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			М							Н		
CO2	Н			L								
CO3					М						Μ	
CO4		L										L
CO5			Η									

# **UNIT I INTRODUCTION TO EMBEDDED SYSTEM**

Introduction, design challenge, processor technology, IC technology, Design technology, Tradeoffs, Single purpose processors, RT-level combinational logic, sequential logic (RT-level), custom single purpose processor design (RT-level) and optimization techniques.

# UNIT II GENERAL PURPOSE PROCESSORS, STATE MACHINE

Basic architecture, operation, Pipelining, Programmer's view, development environment, Application Specific Instruction-Set Processors (ASIPs) – Micro Controllers and Digital Signal Processors, models Vs. languages, finite state machines with data path model (FSMD), using state machines, program state machine model (PSM),

# UNIT III CONCURRENT PROCESS MODELS

Concurrent process model, concurrent processes, communication among processes, synchronization among processes, implementation, data flow model, real-time systems

# UNIT IV COMMUNICATION INTERFACES

Need for communication interfaces, RS232 / UART, RS422 / RS485, USB, Infrared, IEEE 1394 Firmwire, Ethernet, IEEE 802.11, Blue tooth.

# UNIT V APPLICATIONS

Real-Time Embedded Software Development, Sending a Message over a Serial Link, Simulation of a Process Control System, Controlling an Appliance from the RT Linux System, Embedded Database Applications, Embedded medical applications: Ophthalmology - Glaucoma screening device, Medical Imaging Acquisition User Interface, Drug delivery systems, Patient monitoring Systems.

# TEXT BOOKS

- 1. Frank Vahid, Tony D. Givargis, "Embedded System Design A Unified Hardware/Software Introduction", John Wiley, 2002.
- 2. K.V.K.K. Prasad, "Embedded / Real Time Systems", Dreamtech Press, 2005.
- 3. Sri Ram V Iyer Pankaj Gupta, "Embedded Real Time Systems Programming", Tata McGraw Hill, 2005.
- 4. Steve Heath, "Embedded System Design", Elsevier, Second Ed., 2004.

DME19D212 MECHANICS OF DIOLOCICAL SYSTE	MC	L	Т	Р	Credit						
DWIE18K515 MECHANICS OF DIOLOGICAL SISTE	112	3	0	0	3						
Pre-requisite: BME18R351 Course	<b>Course Category: Professional electives</b>										
Cours	<b>Course Type</b> : Theory										

Objective(s) To understand about the needs of a sports person met by a Biomedical Engineer

# **Course Outcome(s)**

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

- **CO1** Illustrate the basics of soft tissue mechanics
- **CO2** Analyze the mechanics of head and neck after having an injury
- **CO3** Distinguish the mechanics of different joints of the body
- **CO4** Interpret the gait analysis
- CO5 Discuss the functions of organs during sports and exercise

# **UNIT I - SOFT TISSUE BIOMECHANICS**

Fundamentals of Soft Tissue Mechanics: Muscle Architecture, Max Muscle Stress, Max Muscle Contraction Velocity, Muscle Force-Length Relationship, Muscle Force-Velocity **Relationship**, Tendon Biomechanics

# **UNIT II - MECHANICS OF HEAD AND NECK**

Injury Mechanisms, Mechanical Response, Regional Tolerance, Biomechanics of Chest and Abdominal Impact, Biomechanical Responses During Impact, Injury Risk Assessment.

# **UNIT III - BIOMECHANICS OF DIFFERENT JOINTS OF HUMAN BODY** (9 HOURS)

Geometry of Articulating Surfaces, Joint Contact, Axes of Rotation of (Ankle, Knee, Hip, Shoulder, Elbow, Wrist, Hand), Tribology (Friction, Wear and Surface Damage), Hydrodynamic Lubrication Theories, Boundary Lubrication, Synovial Joints,

# **UNIT IV - GAIT ANALYSIS**

### (9 HOURS)

# (9 HOURS)

Clinical Gait Analysis Information, Data Collection Protocol, Measurement Approaches and Systems (Stride and Temporal Parameters, Motion Measurement, Ground Reaction Measurement, Dynamic Electromyography)

# UNIT V - PHYSIOLOGY IN SPORTS AND EXERCISE (9 HOURS)

Muscle Energetic, Cardiovascular Adjustments, Maximum Oxygen Uptake, Respiratory Responses, Optimization Techniques, Thermal Response, Applications.

# TEXT BOOKS

- 1. J. D. Bronzino, "Biomedical Engineering Handbook", 3rd ed, CRC Press, 2006.
- 2. Nordine-Frankel, "Basic Biomechanics of the Musculoskeletal System", Lea & Febiger, 2012.
- 3. Arthur T. Johnson, "Biomechanics and Exercise Physiology", 2<sup>nd</sup> edition, John Wiley and Sons, 2007.

# **REFERENCES**

- 1. Duane Knudson, "Fundamentals of Biomechanics", Springer, 2<sup>nd</sup> Edition, 2007.
- 2. Donald R.Peterson, Joseph D.Brozino, "Biomechanics –Principles and Applications", 2<sup>nd</sup> Edition, CRC press, 2007.
- 3. Ross Ethier, Craig A.Simmons, "Introductory Biomechanics-from cells to organisms", 1<sup>st</sup> edition, Cambridge University Press, 2007.
- 4. Cees Oomens, Marcel Brekelmens, Frank Baaijens, "Biomechanics: Concepts and Computation", 1<sup>st</sup> edition, Cambridge University Press, 2010

BME18D/07	HUMAN ASSIST DEVICES		L	Т	Р	С
DIVILION402	HUMAN ASSIST DEVICES		3	0	0	3
<b>Pre-requisite: B</b> <b>Course Type</b> : T	ME18R201 heory	Сог	irse Cate	gory: Prot	fessional e	electives

# **Objective**(s)

- 1. To understand the principle, design and application of various human assist devices which include extracorporeal devices, cardiac assist devices, respiratory devices and hearing aids.
- 2. This course also includes a brief introduction to design aspects of prosthetic and orthotic devices for the disability.

# **Course Outcome(s)**

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

- CO1 Illustrate the various building blocks of Heart lung Machine and its working principle.
- CO2 Understand the principle and working of various cardiac assist devices.
- **CO3** Understand the role and working of artificial kidney.
- **CO4** Ability to specify the type of assistive devices for rehabilitation.
- **CO5** Categorize the different types of respiratory assist devices and hearing aids.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	М											
CO2	Μ			М								
CO3	М			L								
CO4	М			Н								
CO5	М			Н								
UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART (!										(9 H	ours)	

Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Mock test setup for assessing its Functions

# **UNIT II CARDIAC ASSIST DEVICES**

Mapping of COs and Pos

Synchronous Counter pulsation, Assisted through Respiration Right Ventricular Bypass Pump, Left Ventricular Bypass Pump, Open Chest and closed Chest type, Intra Aortic Balloon Pumping Veno Arterial Pumping, Prosthetic Cardio Valves, Principle and problem, Biomaterials for implantable purposes, its characteristics and testing.

# **UNIT III ARTIFICIAL KIDNEY**

Indication and Principle of Haemodialysis, Membrane, Dialysate, Different types of heamodialysers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

# **UNIT IV PROSTHETIC AND ORTHOTIC DEVICES**

Hand and Arm Replacement - Different Types of Models Externally Powered Limb Prosthesis, Lower Limb and Upper limb orthotic devices, Functional Electrical Stimulation, Sensory Assist Devices, Materials for Prosthetic and orthotic devices, Haptic Devices

# **UNIT V RESPIRATORY AND HEARING AIDS**

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, Construction and Functional Characteristics

# REFERENCES

1. Andreas.F.Vonracum, Hand book of bio material evalution, Mc-Millan publishers, 1980.

2. Albert M.Cook and Webster J.G., Therapeutic Medical Devices, Prentice Hall Inc., New Jersey, 1982

3. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York 2004.

4. John. G. Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004.

5. Kolff W.J., Artificial Organs, John Wiley and Sons, New York, 1979.

BME18R403REHABILITATION ENGINEERING	L	Т	Р	Credit
	3	0	0	3

# (9 Hours)

(9Hours)

# (9 Hours)

(9 Hours)

# Pre-requisite: BME18R351

Course Type: Theory

**Objective(s)** Discuss the broad area of rehabilitation engineering and its application to assist people with impairments in sensing, communication, seating, manipulation, and mobility

# Course Outcome(s)

CO1 Study the principles of rehabilitation.

**CO2** Describe the features of human movement in health and disability and discuss the application of these properties in rehabilitation engineering design.

CO3 Learn therapeutic Exercise Techniques.

CO4 Discuss the various rehabilitation communication techniques.

CO5 Understand orthopaedic prosthetics and orthotics in rehabilitation

Mapp	Mapping of COs and Pos													
СО	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		
CO1	L			М								Н		
CO2			М							L				
CO3														
CO4		Η									М			
CO5					L									

# UNIT I INTRODUCTION TO REHABILITATION & REHABILITATION TEAM

# (9 HOURS)

What is Rehabilitation, Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional Diagnosis, Importance of Psychiatry in Functional diagnosis, Impairment disability handicap, Primary & secondary Disabilities, Rehabilitation team-Classification of members,

# UNIT II PRINCIPLES OF REHABILITATION

# (9 HOURS)

Introduction, The Human Component, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles - Practice of Rehabilitation and Assistive Technology.

# UNIT IIITHERAPEUTIC EXERCISE TECHNIQUE(9 HOURS)

Co-ordination exercises, Frenkels exercises, Gait analyses-Pathological Gaits, Gait Training, Relaxation exercises-Methods for training Relaxation, Strengthening exercises-Strength training, Types of Contraction, Mobilization exercises, Endurance exercises.

**UNIT IV PRINCIPLES IN MANAGEMENT OF COMMUNICATION (9 HOURS)** Impairment-introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Augmentative communication-general form of communication, types of visual aids, Hearing aids, Types of conventional hearing aid, Writing aids.

# UNIT VORTHOTIC & PROSTHETIC DEVICES:(9 HOURS)

General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Calipers- FO, AFO, KAFO, HKAFO.

Prosthetic devices: Hand and arm replacement, Body powered prosthetics, Myoelectric controlled prosthetics and Externally powered limb prosthetics.

# TEXT BOOKS

1. Dr. S. Sunder, Rehabilitation Medicine-, 3rd Edition, Jaypee Medical Publications, New Delhi. 2010 (Units I, III, IV & V)

2. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006 (Units II & V).

# **REFERENCES**

- 1. Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor & Francis, CRC press, 2006.
- 2. Susan B O'Sullivan, Thomas J Schmitz, Physical Rehabilitation. 5th Edition, Davis publications, 2007.

BME18D/0/	MODELING OF PHYSIOLOGICA	I SVSTEM	L	Т	Р	Credit
DML10N404	MODELING OF THIS IOLOGICA		3	0	0	3
Pre-requisite:	BME18R251	<b>Course Category</b>	y: Pro	fessic	nal el	ectives
Course Type: 7	Theory					

**Objective**(s) Demonstrates the application of Physiological models.

# **Course Outcome(s)**

**CO1** Understand and appreciate the value and application of Physiological models and Vital organs.

CO2 Implement the transfer function for various physiological organs.

CO3 Model dynamically varying physiological system.

CO4 Understand methods and techniques for analysis and synthesis of dynamic models.

CO5 Develop differential equations to describe the dynamic models, simulate and visualize,

dynamic responses of physiological models using software.

Mapp	ing of C	COs and	l Pos									
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L											
CO2				Н							L	
CO3		L							L			
CO4												М
CO5					М							

# UNIT I SYSTEM CONCEPT

# (9 HOURS)

Review of physiological system modelling- system properties- different configurations of tracheal network, static and dynamic resistance, Thermal resistance in human systems, System with volume storage capacity and its electrical analog, Simplified model of respiratory system, Simulation of aortic segments ,Comparison of muscle model isotonic response, Step response of

resistant / compliant systems –Dye dilution study of circulation, pulse response of first order system.

# UNIT II TRANSFER FUNCTION

System as an operator and use of Transfer function, Bio Engineering of coupled systems, Examples of transformed signals and circuits for transfer function with impedance concept-Development of lung model, Impedance of a two stage ladder network, Measurement of airway resistance.

# UNIT III PERIODIC SIGNALS

Sinusoidal Functions, Analysis of Instrumentation to measure air flow system, second order system – representation of a respiratory system, Evaluation of Transfer function from frequency response for muscle response modes, Relationship between Phase lag and Time Delay-closed loop aspects of pupillary control system, Transient Response of an Undamped Second order system, General Description of Natural Frequency Damping, Physical Significance of under damped responses of post systolic operations in aortic arch.

# UNIT IV FEEDBACK

Characterization of Physiological Feedback systems- Hypophysis adrenal systems, pupillary hippus, Uses and Testing of System Stability, Simulation-Hodgkin-Huxley model, Model of cardiovascular variability.

# UNIT V SIMULATION OF BIOLOGICAL SYSTEM

Simulation of thermal regulation, pressure and flow control in circulation, occulo motor system, Endocrinal system, functioning of receptors, introduction to digital control system.

# <u>TEXT BOOKS</u>

- Johnny T.Ottesen, Mette S.Olufsen, Jesper K.Larsen, "Applied Mathematical Models of Human physiology" 1<sup>st</sup> Edition, SIAM: Society for Industrial and Applied Mathematics, 2004.
- 2. Willian B. Blesser, "A System Approach to Biomedicine", Mc Graw Hill Book Co., New York, 1981 (Units I, II, III, IV).
- 3. MichealC.K.Khoo, "Physiological Control System" Analysis, Simulation and Estimation".- Prentice Hall of India , New Delhi , 2001(Unit V).

# **REFERENCES**

- 1. Richard Skalak and Shu Chien, "Hand Book of Biomedical Engineering", Mc Graw Hill and Co. New York, 1987.
- 2. Douglas S.Rigg., "Control Theory and Physiological Feedback Mechanism", The Wilkliam and Wilkins Co. Baltimore, 1970.

RME18D405 NEUDAL ENCINEEDINC						Р	Credit
DNIE10K405	NEUKAL ENGINEER	AING		3	0	0	3
Pre-requisite:	NilCourse	Category:	Profes	siona	1	(	electives

# (9 HOURS)

# (9 HOURS)

# (9 HOURS)

nervous system. Wallerian Degeneration. Neuronal plasticity - CNS acting drugs and their pharmacokinetics.

### **UNIT V - NERVE RECONSTRUCTION AND REPAIRING** (9 HOURS)

Regeneration of the nervous system. Nerve graft; Neural tissue engineering; Drug delivery system in CNS. Cognitive & neurobehavioral rehabilitation.

# **TEXT BOOKS**

- 1. Mathews G.G. "Neurobiology", 2<sup>nd</sup> edition, Blackwell Science, UK, 2000.
- 2. Malcom Carpenter, "Neuroanatomy", Mc Graw Hill 4thEdition.

# REFERENCES

with nervous system. CO5 Apply neural tissue engineering for rehabilitation Regenerate nervous system

CO3 Describe the electrical conduction happens in nervous system.

**CO1** Explain the structure of neuron and nervous system development.

Upon Completion of the course, the students will be able to

• Be familiar with the nervous system development • Be exposed to neuronal diseases and disorders

• Be familiar with nerve reconstruction and repairing

### **UNIT I - BASICS OF NEURON STRUCTURE AND FUNCTIONS** (9 HOURS)

Nervous system development. Trophic factors, extra cellular matrix components in nervous system development.

CO4 Explain various neuro degenerative, demyelinated and injury related disorders associated

Neuron: structure –function –classification. Glial cells – myelination - Neurotransmitter – types and functions. Synapses - Transport of materials and impulse in neurons; Blood Brain barrier.

# **UNIT II - BRAIN, BRAIN STEM AND SPINAL CORD**

Brain: structures –lobes – functional areas. Brain stem: structures –functional areas. Spinal cord: structure -functions. Concepts of nuclei -Tracts - Reticular formation. Blood supply of Brain and spinal cord.

### **UNIT III - NEUROPHYSIOLOGY & NEURORADIOLOGY** (9 HOURS)

Physiology of nerve conduction. Peripheral nerves – structure & Functions. Synaptic transmission and cellular signaling of Neurons. Electrical activity of the Brain and recording of brain waves. Evoked potentials. Visualization of nervous system.

# **UNIT IV - NEURONAL DISEASES AND DISORDERS(9 HOURS)**

Neuro degeneration: Degenerative, Demyelinated and injury related disorders associated with

**Course Outcome(s)** 

**Objective(s)** The student should be made to:

CO2 Discuss about the brain and Spinal cord

# **Course Type**: Theory

- 1. W. Mark Saltzman Tissue Engineering –Engineering principles for design of replacement organs and tissue –-Oxford University Press Inc New York 2004.
- 2. Park J.B., "Biomaterials Science and Engineering", Plenum Press, 2005

		L	Т	Р	С				
BME18R406	Bio MEMS	3	0	0	3				
	Pre-requisite: NilCourse Category: Pr	ofessiona	l electives						
Course Type: Theory									

**Objective(s)** To understand the principles of MEMS and to design medical devices utilizing the principles

# Course Outcome(s)

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

- CO1 Understand about the materials of MEMs and Microsystems
- CO2 Gain knowledge about microsensors and actuators
- CO3 Understand the fundamentals of MEMs technology
- CO4 Analyze the microfluidic systems
- CO5 Apply the MEMs technology in biological applications

Mapp	Mapping of COs and POs													
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		
CO1	Н													
CO2		Н												
CO3			Μ											
CO4				Н										
CO5					Н									

# UNIT I MEMS AND MICROSYSTEMS

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

# UNIT II MICROSENSORS AND ACTUATORS

Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermo mechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever – microplates, strain, pressure and flow measurements, gyroscope, piezo actuator. Thermal sensors and actuators- micro machined thermocouple probe, Peltier effect hat pumps, thermal flow sensors

# UNIT III MICRO OPTO ELECTRO MECHANICAL SYSTEMS

Fundamental principle of MOEMS technology, light modulators, beam splitter, micro lens, digital micro mirror devices, light detectors, grating light valve, optical switch.

# UNIT IV MICROFLUIDIC SYSTEMS

Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in micro conduits, in sub micrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micropumps-continuous flow system.

# UNIT V BIOMEMS

CAD for MEMs, Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR), DNA hybridization.

# TEXT BOOKS:

- 1. NitaigourPremch and Mahalik, "MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007
- 2. Tai Ran Hsu , "MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002
- 3. Wanjun Wang, Stephen A.Soper, "BioMEMs: Technologies and applications", CRC Press, New York, 2007.

RME18D407TISSUE ENCINEEDINC	L	Т	Р	Credit
DVIETOR40/TISSUE ENGINEERING	3	0	0	3
Pre-requisite:BME18R101Course Category: P	rofess	ional	electi	ves
Course Type: Theory				
		1 •		•

**Objective**(s) To understand the concepts of molecular biology and to aid in new tissue generation and organ transplantation

# Course Outcome(s)

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

- CO1 Have a basic knowledge in tissue engineering
- CO2 Culture cells
- **CO3** Analyze the molecular biology in tissue engineering
- **CO4** Understand the transplantation
- CO5 Get a clear idea on how the tissue engineering applicable for real life

Mapping of COs and Pos													
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	Н	Н											
CO2		L											
CO3		М											
CO4				Н									
CO5					Н								
TINIT	TINT										(0.11/		

**UNIT I INTRODUCTION** 

Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing.

# UNIT II CELL CULTURE

Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization, Bioreactors.

# UNIT III MOLECULAR BIOLOGY ASPECTS

Cell signalling molecules, growth factors, hormone and growth factor signalling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers.

# UNIT IV SCAFFOLD AND TRANSPLANT

Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant immunology stems cells: introduction, hepatopoiesis.

# UNIT V CASE STUDY AND REGULATORY ISSUES

Case study of multiple approaches: cell transplantation for liver, musculoskeletal, cardiovascular, neural, visceral tissue engineering. Ethical, FDA and regulatory issues of tissue engineering.

# <u>TEXT BOOK</u>

1. Clemens van Blitterswijk, Tissue Engineering", Academic Press, 2008

# **REFERENCES**

- 1. Bernhard O.Palsson, "Tissue Engineering", Pearson Education, 1<sup>st</sup> Edition, 2016
- 2. John P.Fisher, antoniosG.Mikos, Joseph D.Bronzino, "Tissue Engineering", CRC Press, 2007
- 3. Endarle, Blanchard &Bronzino, "Introduction to Biomedical Engineering" Academic press.4<sup>th</sup> Edition, 2015
- 4. Robert Lanza, Robert Langer, Joseph P.vacanti, "Principles of Tissue Engineering", Academic Press, 2011.

BME18R408NANOTECHNOLOCY IN MEDI		L	Т	Р	Credit			
DWEIGK400NANOTECHNOLOGI IN WEDN	3	0	0	3				
Pre-requisite: Nil	Pro	fessio	onal o	electives				
Course Type: Theory								
Objective(s) To gain knowledge on nanosystems	and to ap	ply the tech	nique	s for	healtł	n care		

**Objective(s)** To gain knowledge on nanosystems and to apply the techniques for health care industry.

# Course Outcome(s)

# (9 HOURS)

(9 HOURS)

(9 HOURS)

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

- Improvise the knowledge in physics of solid state **CO1**
- **CO2** Understand the fundamentals of nanoscience
- **CO3** Demonstrate the preparation of nanosystems
- CO4 Characterize different nanosystems

**CO5** Apply the knowledge acquired in medicine

Mapp	Mapping of COs and Pos													
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		
CO1	Н													
CO2		L												
CO3			М											
CO4				Н										
CO5					Η									
UNIT	I INTR	ODUC	TION 7	ГО РНУ	SICS	OF SC	DLID S	ТАТЕ			(9 HC	<b>)URS</b> )		

# UNIT I INTRODUCTION TO PHYSICS OF SOLID STATE

Intermolecular forces: thermodynamic aspects - Quantum Mechanical Treatment of the Many-Particle Problem - Potential Energy Surface - Pair Potential Approximation - Advantages and Limitations of the Pair Potential Approximation - Phenomenological Potentials - Pseudo-Potentials - Many-Body Potentials

# UNIT II FUNDAMENTALS OF NANOSCIENCE

Size dependence of properties - Particle size determination - Bulk to nano transition -Semiconducting nanoparticles - Carbon nanostructures - Mechanical properties (hardness, ductility, elasticity) - Optical properties of nanotubes - Electrical properties of nanotubes.

# **UNIT III PREPARATION OF NANOSYSTEMS**

Introduction to nanolithography - Carbon nanotubes: preparation - Synthesis and preparation of nanomaterials (crystalline and thinfilm) - Physical and chemical methods - Control and stability (size, shape, composition).

# UNIT IV CHARACTERIZATION OF NANOSYSTEMS

Thermal Stability - Basic Material Properties - Mean Values and Correlation Functions - X-ray diffraction - Scanning Electron Microscopy - Scanning Tunneling Microscopy - Transmission Electron Microscopy - X-ray absorption spectroscopy – Photoelectron emission spectroscopy.

# **UNIT V APPLICATIONS: POTENTIAL OF NANOTECHNOLOGY IN MEDICINE**

(9 HOURS)

Nanotubes, nanowires, and nanodevices-introduction - Functional Nanostructures - Introduction to molecular electronics - Field emission and Shielding - Microelectromechanical systems (MEMs) - Nanoelectromechanical systems (NEMs) - Molecular and Supramolecular Switches -Biosensors - Qdots - Nanoshells - Nanobiotix - Cancer detection - Drug Delivery using Nanoparticles and Molecular Carriers.

# **TEXT BOOKS**

# (9 HOURS)

# (9 HOURS)

- 1. Di Ventra, Massimiliano; Evoy, Stephane; Heflin, James R., Introduction to Nanoscale Science and Technology, Springer publications, 2004
- 2. Vinod Labhasetwar, Diandra L. Leslie-Pelecky, Biomedical Applications Of Nanotechnology, Wiley-Interscience A John Wiley & Son, Inc., Publication, 2007

# **REFERENCES**

- 1. Chattopadhyay, Introduction to Nanoscience and Naotechnology, PHI, 2009
- 2. B.k. Parthasarathy, Nanoscience and Nanotechnology, Gyan Books, 2007
- 3. Vicki H. Grassian, Nanoscience and Nanotechnology: Environmental and Health Impacts (Hardcover 2008), John Wiley & Sons
- 4. T. Pradeep, Nano The essentials, McGraw-Hill publishers, 2008
- 5. Bhushan, Bharat (Ed.), Springer Handbook of Nanotechnology, Springer publications, 2007
- 6. Tuan Vo-Dinh, Nanotechnology in Biology and Medicine: Methods, Devices, and Applications, CRC Press, Jan 2007

RMF18R400 ADVANCED DICITAL SIGNAL PROCESSING	L	Т	Р	Credit
DWEIGKWO ADVANCED DIGITAL SIGNAL I KOCESSING	3	0	0	3
Pre-requisite:BME18R371 Course Categor	y: Pro	ofessio	onal e	lectives

Course Type: Theory

**Objective(s)** To strengthen students' knowledge of DSP fundamentals and familiarize them with practical aspects of DSP algorithm development and implementation.

# Course Outcome(s)

- Up on completion of the course, the students will be able to
- **CO1** Know the analysis of discrete time signals.
- **CO 2** Understand the modern digital signal processing algorithms and estimate unknown parameters from the measured data.
- **CO 3** Design a filter to remove different types of noises.
- **CO 4** Design a model for speech signal and estimate parameters using modern algorithms.
- **CO 5** Understand different types of transforms.

# **UNIT I - DISCRETE RANDOM PROCESS**

# (9 HOURS)

Discrete Random Processes- Expectation- Variance- Co-Variance- Uniform- Gaussian and Exponentially distributed noise - Hilbert space and inner product for discrete signals - Energy of Discrete Signals- Parseval's Theorem- Wiener Khintchine Relation- Power Spectral Density-Sum Decomposition Theorem- Spectral Factorization Theorem - Discrete Random Signal

Processing by Linear Systems - Simulation of White Noise - Low Pass Filtering of White Noise-

# **UNIT II - POWER SPECTRUM ESTIMATION**

Sample auto correlation-Periodogram- Use of DFT in power spectrum estimation- Nonparametric methods:-Bartlett- Welch and Blackman-Tukey method- Parametric methods:-Model based Approach - AR- MA- ARMA Signal Modelling-Parameter Estimation using Yule-Walker Method- Solutions using Durbin's algorithm

**UNIT III - ADAPTIVE & MULTIRATE SIGNAL PROCESSING** (9 HOURS) FIR adaptive filters – steepest descent adaptive filter – LMS algorithm – convergence of LMS algorithms - Application: noise cancellation - channel equalization - adaptive recursive filters - recursive least squares- Decimation by a factor D - Interpolation by a factor I - Filter Design and implementation for sampling rate conversion: Direct form FIR filter structures - Polyphase filter structure.

# **UNIT IV - SPEECH SIGNAL PROCESSING**

Digital models for speech signal : Mechanism of speech production - model for vocal tractradiation and excitation – complete model – time domain processing of speech signal:- Pitch period estimation – using autocorrelation function – Linear predictive Coding: Basic Principles - autocorrelation method - Durbin recursive solution.

# **UNIT V - ADVANCED TRANSFORMS**

Fourier Transform : Its power and Limitations - Short Time Fourier Transform - The Gabor Transform - Discrete Time Fourier Transform and filter banks - Continuous Wavelet Transform - Wavelet Transform Ideal Case - Perfect Reconstruction Filter Banks and wavelets - Recursive multi-resolution decomposition - Haar Wavelet - Daubechies Wavelet-

# REFERENCES

- 1. Monson H-Hayes Statistical Digital Signal Processing and Modelling- Wiley- 20002.
- 2. John G-Proakis- Dimitris G-Manobakis- Digital Signal Processing- Principles- Algorithms and Applications- Third edition- (2000) Pearson/PHI.
- 3. Roberto Crist- Modern Digital Signal Processing- Thomson Brooks/Cole (2004).
- 4. Raghuveer- M- Rao- Ajit S-Bopardikar- Wavelet Transforms- Introduction to Theory and applications- Pearson Education- Asia- 2000.

# (9 HOURS)

(9 HOURS)

# **OPEN ELECTIVES**

RME18D207MEDICAL OPTICS AND LASEDS	L	Т	Р	Credit
DWIE10K20/WIEDICAL OF TICS AND LASEKS	3	0	0	3

**Objective**(s) To acquire adequate knowledge in physics of light in biological tissues and its application in diagnostic and therapeutic applications.

# **Course Outcome(s)**

....

Upon completion of the course, the students should be able to

- **CO1** Be familiar with property of light in tissues
- CO2 Acquire knowledge in source and detectors of light.
- CO3 Application of light in diagnostic practices.
- CO4 Understand the concept of LASER in therapeutic applications.
- CO5 Be exposed to Optical Holography ----

\_ \_

Mapping	Mapping of COs and Pos												
СО	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	Μ				Μ								
CO2			L										
CO3		Η			L								
CO4													

### CO5 Η **UNIT I - OPTICAL PROPERTIES OF THE TISSUES**

Refraction, scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, optothermal interaction, fluorescence, speckles.

# **UNIT II - INSTRUMENTATION IN PHOTONICS**

Instrumentation for absorption, scattering and emission measurements, excitation light sources high pressure arc lamp, solid state LEDs, optical filters, polarisers, time resolved and phase resolved detectors.

# **UNIT III - APPLICATIONS OF LASERS**

Laser in tissue welding, lasers in dermatology, lasers in ophthalmology, otolaryngology, urology. LASERS in surgery.

### **UNIT IV OPTICAL HOLOGRAPHY**

Wave fronts, interference patterns, principle of hologram, optical hologram, applications.

# **UNIT V - SPECIAL TECHNIQUES**

Near field imaging of biological structures, in-vitro clinical diagnostic, fluorescent spectroscopy, photodynamic therapy.

# **TEXT BOOKS**

- 1. Leon Goldman, M.D., &R.James Rockwell, Jr., "Lasers in Medicine", Gordon and Breach, Science Publishers Inc., 1975.
- 2. Abraham Katzir, "Lasers and Optical Fibers in Medicine", Academic Press Edition, 1998.

# REFERENCES

- 1. Tuan Vo Dirh, "Biomedical Photonics Handbook", CRC Press, Bocaraton, 2003 (Unit I – III, V)
- 2. Glasser, O., "Medical Physics -- Vol 1, 2, 3 "Adam HilgarBrustol Inc, 1987.
- 3. G.David Baxter "Therapeutic Lasers Theory and practice", Churchill Livingstone Publications Edition- 2001.

PME19D214COMDUTEDS IN MEDICINE	L	Т	Р	Credit
BWEI8K314COMFUTEKS IN MEDICINE	3	0	0	3

**Objective(s)** To discuss the various aspects of informatics applied in health industry so that quality of health care is improved.

# **Course Outcome(s)**

- **CO1** To understand the system of information managed in the hospital.
- **CO2** To demonstrate the application of softwares employed in medical data management.
- **CO3** To examine medical imaging data with an assist of computers.
- **CO4** To understand the concept of maintaining digital patient records.
- **CO5** To acquire knowledge in delivering instructions in medicine using computers.

# Mapping of COs and Pos

# (9 HOURS)

(9 HOURS)

(9 HOURS)

(9 HOURS)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L											Н
CO2					Н		Μ				Н	L
CO3		М										Μ
CO4				L	Μ							Η
CO5								М				Н

# **UNIT I - HOSPITAL INFORMATION SYSTEM**

### (9 HOURS)

Introduction –Historical review of the development of computers and informatics – Foundation ontology – use of internet in medicine –Internet vs online services-computer based medical information retrieval.

**UNIT II - COMPUTERISED PATIENT DATABASE MANAGEMENT** (9 HOURS) Data base approach -Automated clinical laboratories – automated method in haematology – chromosome analysis by computer –computerised cytology and histology- Automatic scanning for cervical cancer –computer assisted semen analysis-Radio immuno assays-Intelligent laboratory information system- computerized ECG-computer aided analysis of ECG-computerised EEG and EMG. Computer assisted medical imaging-ultrasound –CT Radiation therapy planning-NMR.

# UNIT III - COMPUTER ASSISTED MEDICAL IMAGING AND DECISION MAKING (9 HOURS)

Computer Assisted Medical Decision Making-Model of CMD-Approaches-Decision Support Systems Algorithms –Analysis –CBR-Production Rule Systems-Cognitive Models-**Semantic** Networks –Decision Analysis in Clinical Medicine –Hospital Information System-Functional Capabilities –Need-Security-Cost Effectiveness. Clinical Information System –Benefits – Sources Of Data-Modes Of Decision –CIS in Obestrics and Gynaecology-Clinical Decision Support.

# **UNIT IV - COMPUTERISED PATIENT RECORD**

Computerised Patient Record –Introduction-History Taking By Computer-Dialogue With The Computer - Computerised Prescriptions For Patients-Introduction-Adverse Drug Reactions-Computer Assisted Patient Education And Health Care Information –Introduction –Health Online –Electronic Communication With Patients-Importance Of Behaviour Modification – Patient Self Management Education-Computers In Case Of Critically III Patients- Introduction –Cognitive System, Engineering –Automated Computer Assisted Fluid And Metabolic Balance –Pulmonary Function Evaluation-Computer Aids For The Handicapped-Computer Assisted Surgery.

# **UNIT V - COMPUTER ASSISTED INSTRUCTION IN MEDICINE(9 HOURS)**

Computer Assisted Drug Discovery And Development, Molecular Modelling By Computer-Computational Representation Of Molecules-Modelling GPCRS-Pharmacophores-New Drugs For Cancer from Gene To Screen – Combinational Chemistry-Metabolomics-Knowledge

Based Drug Discovery-Pharmaco Metabolomics Role Of PET And SPECT In Drug Discovery. Computer Assisted Instruction in Medicine.

# TEXT BOOK

1. R. D. Lee, Computers in Medicine, Tata McGraw Hill Publishing Company Limited, New Delhi, 1993.

# **REFERENCE**

- 1. Harold Sackamn, Biomedical Information Technology, Academic Press, New York.
- 2. S.K.Chachan, PC Organisation, S.K. Kataria and Sons, Delhi 2000

RME18D315BIOMEDICAL INSTRUMENTATION	L	Т	Р	Credit
DME10K515DIOWEDICAL INSTRUMENTATION	3	0	0	3

**Objective(s)** To gain basic knowledge about Bio potentials, Bio electrodes and bioamplifiers and to give a complete exposure of various recording mechanism and to understand the basic principles, working of biomedical instruments.

# **Course Outcome(s)**

- **CO1** To learn several signals that can be measured from the human body.
- CO2 To study different types of electrodes used in bio-potential recording.
- **CO3** To understand how noise from the environment, instruments and other physiologic systems can create artifacts in instrumentation.
- CO4 To understand the theory of how several sensors operate and use these sensors in practical.
- CO5 To design the medical instrument to measure non electrical and analytical parameters.

Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Η											
CO2		L										
CO3			Н			Н						
CO4							L					
CO5			М			Н		Н				Н

# **UNIT I - BIOPOTENTIAL AND ELECTRODES**

# (9 HOURS)

Components of Medical Instrumentation System- Basic Cell Functions, Origin of Biopotentials, Electrical Activity of Cells, Electrode-Electrolyte interface, half cell potential, Polarization-polarizable and non-polarizable electrodes, Ag/AgCl electrodes, Electrode and Skin interface and motion artifact. Body Surface recording electrodes for ECG, EMG, EEG.

# UNIT II - BIOELECTRIC SIGNALS RECORDING AND BIOAMPLIFIERS

# (9 HOURS)

Recording of ECG, EEG and EMG - Einthoven triangle, Standard 12-lead configurations - ECG Machine - EMG machine - 10-20 electrodes placement system for EEG - EEG machine.

Bioamplifiers- Carrier Amplifier, - Isolation Amplifier - Differential amplifier - Chopper Amplifier - Instrumentation Amplifier

UNIT III - MEASUREMENT OF NON-ELECTRICAL PARAMETERS (9 HOURS) Human body Temperature, Measurement of blood pressure – Cardiac output – Heart rate – Heart sound – Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers : finger-tip oxymeter - ESR, GSR measurements .

# UNIT IV - LIFE SUPPORT INSTRUMENTS (9 HOURS)

Pacemaker-Types of Pacemaker, mode of pacing and its application, Defibrillator-AC and DC Defibrillators and their application, Heart Lung machine and its application during surgery, Haemodialysis system and the precautions to be taken during dialysis.

# UNIT V - ANALYTICAL INSTRUMENTAION AND ELECTRICAL SAFETY:

# (9 HOURS)

Principle of colorimetry, photometry and pH measurement. Spectrophotometer; Spectrofluorometer; pH meter. Blood Cell counter; Biochemical analyzers; Na-K analyzer Physiological effects of electrical current, Shock Hazards from electrical equipment and methods of accident prevention

# TEXT BOOK

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2014

# **REFERENCES**

- 1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007
- 2. John G. Webster, "Medical Instrumentation Application and Design", John Willey and Sons, 2009.
- 3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.
- 4. L.A Geddas and L.E.Baker "Principles of Applied Biomedical Instrumentation" 2004.
- 5. John G. Webster, "Bioinstrumentation", John Willey and sons, New York, 2004.
- 6. Myer Kutz "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill Publisher, 2003.

RME18D316DEHABILITATION ENCINEEDINC	L	Т	Р	Credit
DWEIGKSTOREHADILITATION ENGINEERING	3	0	0	3

**Objective(s)** Discuss the broad area of rehabilitation engineering and its application to assist people with impairments in sensing, communication, seating, manipulation, and mobility

# **Course Outcome(s)**

- CO1 Study the principles of rehabilitation.
- **CO2** Describe the features of human movement in health and disability and discuss the application of these properties in rehabilitation engineering design.

- **CO3** Learn therapeutic Exercise Techniques.
- CO4 Discuss the various rehabilitation communication techniques.
- CO5 Understand orthopaedic prosthetics and orthotics in rehabilitation

Mapping of COs and Pos											
PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
L			М								Н
		М							L		
				М							
	Η									М	
				L							
_	PO1 L	PO1 PO2 L H	PO1 PO2 PO3 L M H H	PO1PO2PO3PO4LMMMMHI	PO1       PO2       PO3       PO4       PO5         L       M       M       Image: Constraint of the second secon	PO1       PO2       PO3       PO4       PO5       PO6         L       M       M       I       I         M       M       M       I       I         H       I       M       I       I         I       H       I       I       I	PO1       PO2       PO3       PO4       PO5       PO6       PO7         L       M       M       I       I       I         M       M       I       I       I         M       M       I       I       I         H       I       I       I       I         I       I       I       I       I	PO1       PO2       PO3       PO4       PO5       PO6       PO7       PO8         L       M       M       I       I       I       I         M       M       I       I       I       I       I         M       M       I       I       I       I       I         H       I       I       I       I       I       I         H       I       I       I       I       I       I	PO1       PO2       PO3       PO4       PO5       PO6       PO7       PO8       PO9         L       M       M       I	PO1       PO2       PO3       PO4       PO5       PO6       PO7       PO8       PO9       PO10         L       M       M       I       I       I       I       I       I         M       M       I       I       I       I       I       I       I         M       M       I       I       I       I       I       I       I         M       M       I       I       I       I       I       I       I         H       I       I       I       I       I       I       I       I         H       I       I       I       I       I       I       I       I	PO1       PO2       PO3       PO4       PO5       PO6       PO7       PO8       PO9       PO10       PO11         L       M       I       I       III       IIII       IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII

# **UNIT I - INTRODUCTION TO REHABILITATION & REHABILITATION TEAM** (9 HOURS)

What is Rehabilitation, Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional Diagnosis, Importance of Psychiatry in Functional diagnosis, Impairment disability handicap, Primary & secondary Disabilities, Rehabilitation team-Classification of members.

# **UNIT II - PRINCIPLES OF REHABILITATION**

Introduction, The Human Component, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles - Practice of Rehabilitation and Assistive Technology.

# **UNIT III - THERAPEUTIC EXERCISE TECHNIQUE**

Co-ordination exercises, Frenkels exercises, Gait analyses-Pathological Gaits, Gait Training, Relaxation exercises-Methods for training Relaxation, Strengthening exercises-Strength training, Types of Contraction. Mobilization exercises. Endurance exercises.

### **UNIT IV - PRINCIPLES IN MANAGEMENT OF COMMUNICATION** (9 HOURS)

Impairment - introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Augmentative communication-general form of communication, types of visual aids, Hearing aids, Types of conventional hearing aid, Writing aids.

# **UNIT V - ORTHOTIC & PROSTHETIC DEVICES** General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Calipers- FO, AFO, KAFO, HKAFO.

Prosthetic devices: Hand and arm replacement, Body powered prosthetics, Myoelectric controlled prosthetics and Externally powered limb prosthetics.

# (9 HOURS)

(9 HOURS)

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# TEXT BOOKS

- 1. Dr. S. Sunder, Rehabilitation Medicine-, 3rd Edition, Jaypee Medical Publications, New Delhi. 2010 (Units I, III, IV & V)
- 2. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006 (Units II & V).

# **REFERENCES**

- 1. Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor & Francis, CRC press, 2006.
- 2. Susan B O'Sullivan, Thomas J Schmitz, Physical Rehabilitation. 5th Edition, Davis publications, 2007.

RMF18P317TELEMEDICINE	L	Т	Р	Credit
DWIE10K31/TELEWIEDICINE	3	0	0	3

**Objective**(s) Apply telemetry in healthcare

# **Course Outcome(s)**

- CO1 Apply multimedia technologies in telemedicine
- CO2 Understand telemedical technology.
- **CO3** Learn the key principles for telemedicine and health.
- CO4 Explain Protocols behind encryption techniques for secure transmission of data.
- CO5 Know telemedical standards, mobile telemedicine and it applications

Mapping of COs and Pos												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L											
CO2					L					М		
CO3		Н				Н					Н	
CO4						L						
CO5				М								L

# **UNIT I - TELEMEDICINE AND HEALTH**

History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Telehealth, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine

# **UNIT II - TELEMEDICAL TECHNOLOGY**

Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Micro wave, Modulation techniques, Types of Antenna, Integration and operational issues, Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication. Mobile

# (9 HOURS)

hand held devices and mobile communication. Internet technology and telemedicine using world wide web (www). Video and audio conferencing. Clinical data – local and centralized.

# **UNIT III - TELEMEDICAL STANDARDS**

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-time Telemedicine integrating doctors / Hospitals, Clinical laboratory data, Radiological data, and other clinically significant biomedical data, Administration of centralized medical data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

# **UNIT IV - MOBILE TELEMEDICINE**

Tele radiology: Definition, Basic parts of teleradiology system: Image Acquisition system Display system, Tele pathology, multimedia databases, color images of sufficient resolution, Dynamic range, spatial resolution, compression methods, Interactive control of color, Medical information storage and management for telemedicine- patient information medical history, test reports, medical images diagnosis and treatment. Hospital information system - Doctors, paramedics, facilities available. Pharmaceutical information system.

# **UNIT V - TELEMEDICAL APPLICATIONS**

Telemedicine access to health care services – health education and self care. Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability. Telemedicine access to health care services – health education and self care, Business aspects - Project planning and costing, Usage of telemedicine.

# **TEXT BOOK**

1. Norris, A.C. "Essentials of Telemedicine and Telecare", Wiley, 2002

# **REFERENCES**

- Wootton, R., Craig, J., Patterson, V. (Eds.), "Introduction to Telemedicine. Royal Society of Medicine" Press Ltd, Taylor & Francis 2006
- 2. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), "Public Health Informatics and Information Systems", Springer, 2003.
- 3. Ferrer-Roca, O., Sosa Iudicissa, M. (Eds.), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54, 2002.
- 4. Simpson, W. Video over IP. A practical guide to technology and applications. Focal Press Elsevier, 2006.
- 5. Bemmel, J.H. van, Musen, M.A. (Eds.) Handbook of Medical Informatics. Heidelberg, Germany: Springer, 2002.
- 6. Mohan Bansal, "Medical Informatics", Tata McGraw-Hill, 2004.

# (9 HOURS)

# (9 HOURS)

PME18D/10TISSUE ENCINEEDINC	L	Т	Р	Credit
DIVIETORATOTISSUE ENGINEERING	3	0	0	3

**Objective(s)** To understand the concepts of molecular biology and to aid in new tissue generation and organ transplantation

# Course Outcome(s)

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

- CO1 Have a basic knowledge in tissue engineering
- CO2 Culture cells
- CO3 Analyze the molecular biology in tissue engineering
- CO4 Understand the transplantation

# **CO5** Get a clear idea on how the tissue engineering applicable for real life

# Mapping of COs and Pos

11	0											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Н	Н										
CO2		L										
CO3		М										
CO4				Н								
CO5					Н							

# **UNIT I - INTRODUCTION**

Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing.

# **UNIT II - CELL CULTURE**

Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization, Bioreactors.

# UNIT III - MOLECULAR BIOLOGY ASPECTS

Cell signalling molecules, growth factors, hormone and growth factor signalling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers.

# **UNIT IV - SCAFFOLD AND TRANSPLANT**

Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant immunology stems cells: introduction, haematopoiesis.

100

# **UNIT V - CASE STUDY AND REGULATORY ISSUES**

# (9 HOURS)

(9 HOURS)

(9 HOURS)

# (9 HOURS)

Case study of multiple approaches: cell transplantation for liver, musculoskeletal, cardiovascular, neural, visceral tissue engineering. Ethical, FDA and regulatory issues of tissue engineering.

# TEXT BOOK

1. Clemens van Blitterswijk, Tissue Engineering", Academic Press, 2008

# **REFERENCES**

- 1. Bernhard O.Palsson, "Tissue Engineering", Pearson Education, 1<sup>st</sup> Edition, 2016
- 2. John P.Fisher, antoniosG.Mikos, Joseph D.Bronzino, "Tissue Engineering", CRC Press, 2007
- 3. Endarle, Blanchard &Bronzino, "Introduction to Biomedical Engineering" Academic press.4<sup>th</sup> Edition, 2015
- 4. Robert Lanza, Robert Langer, Joseph P.vacanti, "Principles of Tissue Engineering", Academic Press, 2011.

BME19D411WEADARI E SVSTEMS	L	Т	Р	Credit
DWE10K411WEARABLE SISIEWIS			0	3

**Objective**(s) To design new medical devices based on wearable sensors

# Course Outcome(s)

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

- CO1 Differentiate the sensors that can be used for wearable systems
- CO2 Process the signals picked by the wearable sensors
- CO3 Utilize different sources of energy to be used for wearable systems
- CO4 Analyze the technical aspects of wireless health systems
- CO5 Apply the wearable sensors into novel medical applications

Mapp	Mapping of COs and Pos														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12			
CO1	L														
CO2		Μ													
CO3		Н				L									
CO4		Н	Н		Н										
CO5		Н		L	Н										

# **UNIT I - SENSORS**

# (9 HOURS)

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

# **UNIT II - SIGNAL PROCESSING**

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, Data mining.

### **UNIT III - ENERGY HARVESTING FOR WEARABLE DEVICES** (9 HOURS)

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

# **UNIT IV - WIRELESS HEALTH SYSTEMS**

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

### **UNIT V APPLICATIONS OF WEARABLE SYSTEMS** (9 HOURS)

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

# **TEXT BOOKS**

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

# REFERENCES

- 1. Hang, Yuan-Ting, "wearable medical sensors and systems", Springer-2013
- 2. Mehmet R. Yuce, JamilY.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 Personalised Health Management - State of the art and future challenges ' IOS press, The Netherlands, 2004.

BME18D412NA NOTECHNOLOCV IN MEDICINE	L	Т	Р	Credit
DWIE10K412NANOTECHNOLOGT IN WEDICINE	3	0	0	3

**Objective(s)** To gain knowledge on nanosystems and to apply the techniques for health care industry.

# **Course Outcome(s)**

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

- **CO1** Improvise the knowledge in physics of solid state
- **CO2** Understand the fundamentals of nanoscience
- **CO3** Demonstrate the preparation of nanosystems
- **CO4** Characterize different nanosystems
- **CO5** Apply the knowledge acquired in medicine

# Mapping of COs and Pos

	0											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

# (9 HOURS)

CO1	Η								
CO2		L							
CO3			Μ						
CO4				Η					
CO5					Η				

# **UNIT I - INTRODUCTION TO PHYSICS OF SOLID STATE**

Intermolecular forces: thermodynamic aspects - Quantum Mechanical Treatment of the Many-Particle Problem - Potential Energy Surface - Pair Potential Approximation - Advantages and Limitations of the Pair Potential Approximation - Phenomenological Potentials - Pseudo-Potentials - Many-Body Potentials.

# **UNIT II - FUNDAMENTALS OF NANOSCIENCE**

Size dependence of properties - Particle size determination - Bulk to nano transition -Semiconducting nanoparticles - Carbon nanostructures - Mechanical properties (hardness, ductility, elasticity) - Optical properties of nanotubes - Electrical properties of nanotubes.

# **UNIT III - PREPARATION OF NANOSYSTEMS**

Introduction to nanolithography - Carbon nanotubes: preparation - Synthesis and preparation of nanomaterials (crystalline and thin film) - Physical and chemical methods - Control and stability (size, shape, composition).

# **UNIT IV - CHARACTERIZATION OF NANOSYSTEMS**

Thermal Stability - Basic Material Properties - Mean Values and Correlation Functions - X-ray diffraction - Scanning Electron Microscopy - Scanning Tunnelling Microscopy - Electron Microscopy - X-ray absorption spectroscopy – Photoelectron emission spectroscopy.

# **UNIT V - APPLICATIONS: POTENTIAL OF NANOTECHNOLOGY IN MEDICINE** (9 HOURS)

Nanotubes, nanowires, and nanodevices-introduction - Functional Nanostructures - Introduction to molecular electronics - Field emission and Shielding - Microelectromechanical systems (MEMs) - Nanoelectromechanical systems (NEMs) - Molecular and Supramolecular Switches -Biosensors - Qdots - Nanoshells - Nanobiotix - Cancer detection - Drug Delivery using Nanoparticles and Molecular Carriers.

# **TEXT BOOKS**

- 1. Di Ventra, Massimiliano; Evoy, Stephane; Heflin, James R., Introduction to Nanoscale Science and Technology, Springer publications, 2004
- 2. Vinod Labhasetwar, Diandra L. Leslie-Pelecky, Biomedical Of Applications Nanotechnology, Wiley-Interscience A John Wiley & Son, Inc., Publication, 2007

# REFERENCES

- 1. Chattopadhyay, Introduction to Nanoscience and Naotechnology, PHI, 2009
- 2. B.k. Parthasarathy, Nanoscience and Nanotechnology, Gyan Books, 2007
- 3. Vicki H. Grassian, Nanoscience and Nanotechnology: Environmental and Health Impacts (Hardcover - 2008), John Wiley & Sons
- 4. T. Pradeep, Nano The essentials, McGraw-Hill publishers, 2008

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# (9 HOURS)

(9 HOURS)

### (9 HOURS)

- 5. Bhushan, Bharat (Ed.), Springer Handbook of Nanotechnology, Springer publications, 2nd rev. and extended ed., 2007
- 6. Tuan Vo-Dinh, Nanotechnology in Biology and Medicine: Methods, Devices, and Applications, CRC Press, Jan 2007

DME10D412DIOMETRIC SYSTEMS	L	Т	Р	Credit
BWIE18K413BIOWIE1KIC SYSTEMIS	3	0	0	3

**Objective**(s) To understand the existing biometric systems and to develop novel Biometric systems utilizing unique features of the human body

# Course Outcome(s)

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

- **CO1** Understand the concept of Biometrics and its applications
- CO2 Illustrate the various methodologies involved in fingerprint technology
- **CO3** Develop techniques for face recognition and hand geometry biometrics
- CO4 Demonstrate the multimodal biometrics and the methods for evaluating the performance

CO5 Distinguish the authentication mechanism of the biometric systems

Mapp	Mapping of COs and Pos													
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		
CO1	L													
CO2				М										
CO3		Μ												
CO4		Н												
CO5			М		Η									

# **UNIT I - INTRODUCTION TO BIOMETRICS**

# (9 HOURS)

Introduction and back ground – biometric technologies – passive biometrics – active biometrics -Biometric systems – Enrollment – templates – algorithm – verification – Biometric applications –biometric characteristics- Authentication technologies –Need for strong authentication – Protecting privacy and biometrics and policy – Biometric applications – biometric characteristics UNIT II - FINGERPRINT TECHNOLOGY (9 HOURS)

History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – computer enhancement and modeling of fingerprint images – fingerprint enhancement – Feature extraction – fingerprint classification – fingerprint matching

UNIT III - FACE RECOGNITION AND HAND GEOMETRY (9 HOURS) Introduction to face recognition, Neural networks for face recognition – face recognition from correspondence maps – Hand geometry – scanning – Feature Extraction - Adaptive Classifiers -Visual-Based Feature Extraction and Pattern Classification - feature extraction – types of algorithm - Biometric fusion.

# UNIT IV - MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION (9 HOURS)

Voice Scan – physiological biometrics –Behavioral Biometrics - Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy –training and adaptability – examples of multimodal biometric systems – Performance evaluation- Statistical Measures of Biometrics – FAR – FRR – FTE – EER – Memory requirement and allocation.

# **UNIT V - BIOMETRIC AUTHENTICATION**

# (9 HOURS)

Introduction - Biometric Authentication Methods - Biometric Authentication Systems – Biometric authentication by fingerprint -Biometric Authentication by Face Recognition. Expectation- Maximization theory - Support Vector Machines. Biometric authentication by fingerprint –biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication

# TEXT BOOKS

- 1. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, "Biometric Systems, Technology Design and Performance Evaluation", Springer, 2005 (Units I, II, III & IV)
- 2. S.Y. Kung, S.H. Lin, M.W.Mak, "Biometric Authentication: A Machine Learning Approach" Prentice Hall, 2005(Unit V)

# **REFERENCES**

- 1. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004.
- 2. Nalini K Ratha, Ruud Bolle, "Automatic fingerprint Recognition System", Springer, 2003

DME19D414DIOMEDICAL WASTE MANACEMENT	L	Т	Р	Credit
DME18K414DIOWEDICAL WASTE MANAGEMENT	3	0	0	3

**Objective(s)** To understand the hazards of biomedical waste and to dispose it in a right way as per the guidelines

# **Course Outcome(s)**

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

- **CO1** Distinguish the different types of hazardous biomedical waste, its handling and disposal methodologies
- CO2 Enumerate the hazards caused by non disposal of medical waste
- CO3 Analyze the various treatment techniques of processing biomedical waste
- CO4 Illustrate the laws for handling the biomedical waste
- CO5 Demonstrate the guidelines provided by WHO for management of hospital waste

# Mapping of COs and Pos

·· I· I·	0											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	Η									
CO2		М					Н			
CO3						Н		М		
CO4			Н							
CO5				Η					Н	Н

# **UNIT I - INTRODUCTION**

Definition of general and hazardous health care waste, Infectious waste, geno-toxic waste, waste sharps, categorization and composition of Biomedical waste, major and minor sources of biomedical waste, Segregation of waste, Color coding, waste handling and disposal

# **UNIT II - HAZARD OF BIOMEDICAL WASTE**

Need for disposal of biomedical waste, Specifically Communicable diseases, Diseases epidemiology and mode of transmission of disease, Environmental pollution by biomedical waste - causes, consequences, mitigation and remedies.

# **UNIT III - TREATMENT TECHNOLOGIES FOR WASTES**

Mechanical Treatment & Chemical Disinfections, Conventional Treatment Technologies: Wet thermal technology, Incineration, Microwave Technology, Autoclave system, Hydro clave system, Electro Thermal Reactivation (ETP), Treatment Process Electron beam Technology, Plasma Pyrolysis/ Gasificaton systems

**UNIT IV - LAWS OF BIOMEDICAL WASTE HANDLING** Legislation, policies and law regarding environment on Health care waste management, Biomedical waste management and handling rules 1998 and its amendment.

# **UNIT V - GUIDELINES**

CPCB guidelines. World Health Organization guidelines on Management of wastes from Hospital wastes.

# **REFERENCES**

- 1. Anantpreet Singh, Sukhjit Kaur, "Biomedical Waste Disposal", 1st ed., Jaypee Publishers (P) Ltd, India, 2012.
- 2. Sushma Sahai, "Bio-Medical Waste Management", APH Publishing Corporation, India, 2009.
- 3. Sanskriti Sharma, "Hospital Waste Management and Its Monitoring", Jaypee Publishers (P) Ltd, India, 2002.

DME10D415DIOETHICS IDD AND STANDADDS	L	Т	Р	Credit
BME18K415BIOETHICS, IPR AND STANDARDS	3	0	0	3

**Objective**(s) To understand the standards to be maintained while designing biomedical devices considering bioethics

# **Course Outcome(s)**

# (9 HOURS)

(9 HOURS)

(9 HOURS)

# (9 HOURS)

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

- **CO1** Understand the biomedical ethics
- **CO2** Analyze the issues arise in biomedical devices
- CO3 Know about the basic principles of IPR law
- CO4 Describe about the safety measures in order to use a biomedical device
- CO5 Understand the biomedical standards

# Mapping of COs and Pos

··· I· I·	8											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								Н				
CO2		Н						Н				
CO3								Н				
CO4				Н				Н				
CO5					Н			Н				

# **UNIT I - BIOMEDICAL ETHICS**

# (9 HOURS)

(9 HOURS)

(9 HOURS)

(9 HOURS)

Principles, rules and moral decisions of biomedical ethics, respect for autonomy, voluntariness information and informed consent, competency, non-maleficence, the rule of the double effect, beneficence, paternalism, justice.

# UNIT II - ETHICAL ISSUES IN DESIGN AND MANUFACTURE OF MEDICAL DEVICES (9 HOURS)

Cost benefit analysis, professional restrictions and responsibility, rights of engineers, conflict of interest, codes of ethics for biomedical engineers, ethics of implant use and marketing.

# UNIT III - BASIC PRINCIPLES OF IPR LAWS

# History of IPR-GATT, WTO, WIPO & TRIPs, Role of IPR in Research & Development, Concept of property, Different forms of IPR – copyright, trade mark, Industrial Designs, Layout designs of Integrated circuits, Patents, Geographical Indications, Traditional Knowledge, Plant varieties, Trade secrets.

# **UNIT IV - SAFETY**

Regulatory Authorities for medical device regulation in India (CDSCO), Global Harmonization Task Force for device regulation abroad, Quality management system for medical devices (ISO 9001 and ISO13485)

# UNIT V STANDARDS

Safety and standardization for risk management (ISO 14971), European standard conformity (CE marking), FDA guidelines for medical devices approval and classification based on risk assessment.

# **REFERENCES**

- 1. Daniel A Vallero, "Biomedical ethics for Engineers", Academic Press, New York, 2007.
- 2. PrabuddghaGanguli, "Intellectual Property Rights", TMH Publishing Co. Ltd., 2001.
- 3. Patents by N.R. Subbaram, Pharma Book Syndicate, Hyderabad, India, 2006.

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		3	0	0	3
0	0				

# **Course Outcomes:**

CO-1: Know the fundamentals of fibre based optical devices

CO-2: Understand the basic of integrated optical devices

- CO-3: Learn about the opto electronic devices
- CO-4: Understanding of nanostructured materials

CO-5: Understanding of quantum devices with applications

# **Unit – I : OPTICAL FIBRE BASED DEVICES**

Fused single mode fibre directional coupler, Polished single mode fibre directional coupler ;Fibrepolariser; Polarisation splitters based on fibre; Single mode fibre filter; Polarisation controller; Wavelength multiplexer and demultiplexer; Optical fibre switches and intensity modulators; Optical fibre phase modulator; Optical fibre frequency modulator; Optical fibre amplifiers

# **Unit – II : INTEGRATED OPTIC BASED DEVICES**

Optical directional coupler: directional coupler wavelength filter, polarisation splitting directional coupler; Polarisers : leaky mode polariser , metal clad polariser; Phase modulator; Optical switch; Acousto-optic devices : mode converter , tunable wavelength filter, Bragg type modulator , Bragg type deflector; Magneto-optic devices : TE-TM mode converter, modulators and switches, SiO2 / Si based thin film devices , Ti / LiNbO3 based optical devices, Proton exchange based optical devices .

# **Unit – III : OPTOELECTRONIC DEVICES**

Semiconductor Lasers: heterojunction and surface emitting lasers, quantum well lasers; Modulation of lasers; Photodetectors: PIN, MSM, Avalanche photodiodes; Optoelectronic modulation and switching devices; Electro-optic Devices; Optoelectronic Integrated circuits

# **Unit – IV: NANOSTRUCTURES**

Nanocrystals: Electronic states, properties and fabrication; Nanomaterials – preparation methods - Chemical vapour deposition- Sol-gel methods - Optical properties of nanostructures; nano photodetector, nano transistor

# **Unit – V :QUANTUM DEVICES**

Low-dimensional structures: Quantum wells, Quantum wires, and Quantum dots; Density of states in low-dimensional structures; Resonant tunneling phenomena and applications in diodes and transistors; Applications of quantum devices: quantum well and quantum dot lasers, ultra-fast switching devices, high density memories, dc and rf squids, multi-state logic circuits, long wavelength detectors

# **Reference Books**

1. Joachim Piprek, Semiconductor optoelectronic devices, Academic press Hardbound, 2003

2. A.K. Ganguly, Optoelectronic devices and circuits, Narosa publication, 2007
3. Shun Lien Chuang, Physics of Optoelectronic Devices, Wiley-Interscience; 1st ed., 1995

4. Goure and I Verrier, Optical Fibre Devices, Taylor & Francis; 1<sup>st</sup> ed., 2001

5. Ray Tricker, Optoelectronics and Fiber Optic Technology, Newnes, 2002

6. K Krishna Reddy M Balakrishna Rao, Nanostructures & Quantum Devices, Campus, Books International,2007

7. Rahman Faiz, Nanostructures in Electronics and Photonics, pan stallion press

8. Guozhong Cao, Nano structures & nano materials: synthesis, properties & applications, Imperial College Press, 2004

9. Todd D. Steiner, Semiconductor nanostructures for optoelectronic application, Artech House, INC.,2004

10. Jia- Ming Liu, Photonic Devices, Cambride University Press, 2005

# **HUMANITIES ELECTIVES**

HSS18D001MANACEMENT CONCEDTS AND T	FCHNIOUES	L	Т	Р	Credit
IISSIGKUUIWANAGEWENT CONCELTS AND T	3	0	0	3	
Pre requisite: NIL	Course Categor	y: Hu	manit	ies el	ectives
Course Type: Theory					

#### **Course Description:**

This course addresses the definition of management, its characteristics, evolution and importance as well as the functions performed by manages-planning, organizing, directing and controlling. The course also intends to show students the applications of management functions in various enterprises such as marketing, finance, personnel, production, etc.

#### **Course Outcomes:**

The students will be able

CO's	Course Outcomes
CO1	To Explain the historical backdrop and fundamentals of Management thoughts vital
	understanding the conceptual frame work of Management as a discipline.
CO2	To Discuss about the various concepts of planning, Decision making and controlling
02	to help solving managerial problems
CO3	To Understanding concepts of Ethics, Delegation, Coordination and Team work
CO4	To Study and understand the management concepts and styles in Global context
CO5	To develop an understanding about emerging concepts in management thought and
005	philosophy

# **Mapping of Course Outcome(s):**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	М											
CO2												
CO3		М										
CO4		М										
CO5										М		
UNIT	UNIT I : DEVELOPMENT OF MANAGEMENT THOUGH(9 HOURS)											
Scien	Scientific Management Movement Administrative Movement Human Polations Movement											

Scientific Management Movement - Administrative Movement - Human Relations Movement -Decision Movement - Behavioral Science Movement - Systems Movement - Contingency Movement.

# **UNIT II: ESSENTIALS OF PLANNING**

Planning Objectives - Goals - Programmed Decisions and Unprogrammed Decisions; Decision - Making - Creativity in Decision - Making, Forecasting and Strategy to Formulation.

### **UNIT III : EFFECTIVE ORGANIZING**

Span of Control – Departmentation - Authority; Responsibility - Bureaucracy and Adhocracy; Group Dynamics.

# **UNIT IV : STAFFING AND DIRECTING**

Staffing: Manpower Planning – Recruitment Sources – Selection Procedure – Training Methods - Performance Evaluation Methods - Executive Development Programs - Directing: Communication Process and Barriers – Motivation Techniques – Financial and Non – Financial Motivation- Leadership Qualities and Styles.

# **UNIT V: CONTROLLING AND RECENT CONCEPTS**

Controlling: Meaning and Process - Requisites of Effective Control - Control Techniques. Emerging Issues in Management: Japanese and American Management - Management by Objectives - Knowledge Management - Technology Management - Business Process Outsourcing- Social Responsibility and Business Ethics.

# TEXT BOOKS

# (9 HOURS)

(9 HOURS)

(9 HOURS)

- 1. Harold Koontz & Heinz Weihrich, Essentials of Management: An International, Innovation and Leadership Perspective, 10<sup>th</sup> Edition, McGraw Hill Education (India) Private Ltd. New Delhi, 2016.
- 2. Stephen P. Robbins, Mary A. Coulter, Management, 13<sup>th</sup> Edition, Pearson Education Limited, New Delhi, 2016

#### **REFERENCE BOOKS**

- 1. C.B.Gupta, Management Theory and Practice, 19<sup>th</sup> Revised Edition, Sultan Chand & Sons, New Delhi.2017.
- 2. L.M.Prasad, Principles and Practices of Management, 9<sup>th</sup> Edition, Sultan Chand and Sons Private Limited, 2015.
- 3. K.Aswathappa, Essentials of Business Environment: Text Cases and Exercises 12<sup>th</sup>, edition, Himalaya Publishing House, Mumbai, 2014.
- 4. Tripathi & Reddy, Principles of Management, 5<sup>th</sup> Edition, Tata McGraw Hill publishing company Ltd, New Delhi, 2012.

HCC10D002NAA DIZETINICI NAANIA CIEMENIT	L	Т	Р	Credit			
HSS18KUU2MAKKEIING MANAGEMENI	3	0	0	3			
Pre requisite: NIL C	Course Category: Humanities electives						
Course Type: Theory							

#### **Course Description:**

This course develops students understanding of how organizations match the requirements of consumers in competitive environments, and develop strategies to create the competitive edge. It covers areas such as analysis, planning, implementation, and control, as well as the marketing mix, exportation, and the social aspects of marketing.

### **Course Outcomes:**

CO's	Course Outcomes
CO1	To Develop understanding of marketing concepts, philosophies and historical
	ckground.
CO2	To Develop understanding of marketing operations and complexities for students to
	apply in practical business situations.
	To Understand concepts related to Segmentation, Targeting and Positioning,
CO3	product attributes, and pricing strategies prevalent in domestic and international
	scenario.
CO4	To Study various tools and techniques of promoting the products in ethical manner.
CO5	To Understand emerging concepts of marketing in the emerging global markets

Mapping of Course Outcome(s)												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Μ								М			
CO2												

# **COUSE DESCRIPTION:**

**Pre requisite: NIL** 

**Course Type**: Theory

HSS18R003ORGANIZATIONAL PSYCHOLOGY

This course aims to clarify the principles and basic concepts of organizational psychology. Including organizations and understanding its business design based on efficiency and quality of employee life. It also aims at enhancing the quality of life of employees. When organization's

### Meaning - Product planning - policies - positioning - New product development Product life cycle – BCG Matrix - branding. Packing, labeling.

Μ

**UNIT III : PRICING** 

**UNIT II: PRODUCT** 

CO3

Pricing objectives - Setting and modifying the price - Different pricing method Product line pricing and new product pricing.

# **UNIT IV: DISTRIBUTION**

Nature of Marketing channels - Types of Channel flows - Channel functions - Channel cooperation, conflict and competition - Direct Marketing Telemarketing, Internet shopping.

# **UNIT V: PROMOTION**

Promotion Mix - Advertisement - Message - copy writing - Advertisement - budgeting -Measuring advertisement effectiveness - Media strategy - sales promotion - Personal selling steps, publicity and direct marketing.

# **TEXT BOOKS**

Philip.T.Khotler, Kevin Lane Keller, Marketing Management, 15th Edition, Pearson 1. Education, New Delhi, 2016.

2. Ramaswamy.VS&Namakumari. S, Marketing Management – Global Perspective, Indian Context, McGraw Hill Education (India) Private Limited, New Delhi, 2013.

### **REFERENCE BOOKS**

Rajan Saxena, Dorector, Jain S.P., Marketing Management, 1<sup>st</sup> edition, Tata McGraw 1. Hill, New Delhi, 2006.

K.S.Chandrasekar, Marketing Management, Text & Cases, 1<sup>st</sup> edition, Tata McGraw hill 2. Education Pvt. Ltd. 2013.

TapanK.Panda, Marketing Management Text and Cases, 2<sup>nd</sup> Edition, Excel Books.2008. 3.

UNIT	I:MA	RKET	ING				(9 HO	URS)
CO5		М						
CO4						Μ		

Meaning - concept - functions - marketing Planning & implementation marketing Programmes -Marketing environment – Market Segmentation and consumer behaviour – Influencing factors, Decision process –Marketing mix – Marketing department.

# (9 HOURS)

(9 HOURS)

(9 HOURS)

#### 112

(9 HOURS)

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L

3

**Course Category:** Humanities electives

Р

0

Credit

3

aspects are gauged in terms of psychological assessment, personnel decisions in line with training and development, organizational change and organizational health in specific the intrinsic problems are understood paving way towards standards that are high.

#### **COURSE OUTCOMES**

The students will be able

S.NO	DESCRIPTION
CO1	To learn basic concepts of industrial and organizational psychology
CO2	To illustrate different ways of achieving organizational effectiveness through individual behaviour.
CO3	To learn the concepts relating to individual behavior to achieve group target and achieve leadership position in organization.
CO4	To understand the organizational changes and means to evaluate based on nature of orgnizations.
CO5	To learn implications of changes aligning the interest of individual, group and organization as a whole.

Mapping of Course Outcome(s)												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Μ											
CO2												
CO3	Μ											
CO4		М										
CO5										М		

#### **UNIT I: FOCUS AND PURPOSE**

Organizational Behaviour - Need and importance, nature and scope, framework.

#### **UNIT II : INDIVIDUAL BEHAVIOUR**

Personality - types - factors influencing personality - theories - learning - types of learners learning theories – organizational Behaviour modification. Attitudes – characteristics – components - formation - measurement. Perceptions - importance - factors influencing perception - interpersonal perception.

### **UNIT III: GROUP BEHAVIOUR**

Organization structure - formation - groups in organizations - influence - group dynamics emergence of informal leaders and working norms - group decision making techniques interpersonal relations -communication process and Group Communication.

#### **UNIT IV : LEADERSHIP**

Leadership styles - theories - Qualities - leaders Vs managers - sources of power - power centers - power and Organisational Politics- Motivation.

### **UNIT V: ORGANISATIONAL DEVELOPMENT**

(9 HOURS)

#### (9 HOURS)

(9 HOURS)

(9 HOURS)

Organizational development - Importance, characteristics, objectives, stability Vs change, proactive vs reaction change, the change process, resistance to change, managing change, team building - Organizational effectiveness, perspective, effectiveness Vs efficiency, approaches, the time dimension, achieving organizational effectiveness.

# TEXT BOOKS

- 1. Stephen P.Robins and Timothy A . Judge, Organisational Behavior, Peason Education, 17th edition, 2017.
- 2. Fred Luthans, Organisational Behavior, McGraw Education, 12<sup>th</sup> Edition, 2010.

# **REFERENCES**

- 1. Aswathappa, Organisational Behavior, Himalaya Publishing House, 12th edition, 2016.
- 2. P.Subba Rao, Management and Organisational behavior: Text, Cases and Games, Himalaya Publishing House, 1st edition, 2010.
- 3. Mullins, Organisational Behavior, Pearson Education Limited, 9th edition, 2010.
- 4. L.M.Prasad, Organisational Behaviour, 5th edition, Sultan Chand and Sons, New Delhi, 2014.

HSS18R00/PROJECT MANACEMENT	L	Т	Р	Credit		
IISSIGKUUHI KOJECT MANAGEMENT	3	0	0	3		
Pre requisite: NILCourse Cat	Course Category: Humanities electives					
Course Type: Theory						

### **Course Description**

This course describes concepts relating to project management and enable students to evolve project objectives appropriately with relevance to business proposals. It covers the required dimensions relating to evaluation of project by testing the technical feasibility, financial viability, market acceptability and social desirability of projects. It gives an account on risk and profitability analysis that facilitates the making of the effective project proposal and guides learners in project planning, implementation and control. It also emancipates the scope of project management in undertaking foreign collaboration projects.

### **Course Outcomes**

CO1	Familiarizes the concept of project and steps in project management.
CO2	Understand the basics stages involved in preparing business proposals.
CO3	Evaluate the technical feasibility, financial viability, market acceptability and social sirability of projects.
<b>CO4</b>	Enabled to analyse the Risk and profitability of the project proposals
CO5	Act effectively as project managers and as part of project teams.

Mapp	Mapping of Course Outcome(s):											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						М						
CO2		М										
CO3			М									
CO4												
CO5									М			
UNIT	I: INT	RODU	CTION	TO PI	ROJEC	T MAN	NAGEN	<b>AENT</b>			(9 HC	DURS)

#### **UNIT I: INTRODUCTION TO PROJECT MANAGEMENT**

Projects - Project ideas and preliminary screening. Developments - Project planning to Project completion - Pre-investment phase, Investment phase, operational phase - Governmental Regulatory framework. Capital Budgeting .

### **UNIT II: STAGES OF PROJECT MANAGEMENT**

Opportunity studies - prefeasibility studies, functional studies or support studies, feasibility study expansion projects, data for feasibility study. Market and Technical Appraisal : Market and Demand analysis, Market Survey, Demand forecasting. Technical analysis- Materials and inputs, Choice of Technology, Product mix, Plant location, capacity, Machinery and equipment.

### **UNIT III: APPRAISAL PROCESS**

Concepts. Time value of money - Present and future value. Appraisal criteria - Urgency, Payback period, Rate of return, Debt service coverage ratio, Net present value, Benefit cost ratio, Internal rate of return, Annual capital charge, Investment appraisal in practice.

### **UNIT IV: RISK AND PROFITABILITY ANALYSIS**

Risk analysis- Measures of risk, Sensitivity analysis, and Decision tree analysis. Means of financing, Term Loans, Financial Institutions. Cost of capital. Profitability - Cost of Production, Break-even analysis. Assessing the tax burden and financial projections.

# **UNIT V: PROJECT PLANNING, IMPLEMENTATION, AND CONTROL**

#### (9 HOURS)

Forms of Project Organization, Project Planning, Implementation, and Control - Network construction, CPM, PERT, Development of Project schedule, Crashing of Project Network. Introduction to Foreign collaboration projects - Governmental policy framework, Need for foreign technology, Royalty payments, Foreign investments and procedural aspects.

### **TEXT BOOKS**

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- 1. Prasanna Chandra, Projects: Planning, Analysis, Selection, Financing, Implementation, 8<sup>th</sup> Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2014.
- 2. M.R. Gopalan, Project Management Core Textbook, (Paper Back) 2<sup>nd</sup> edition, Wiley India, 2015

# REFERENCES

- 1. Harold Kerzne, Project Management Best Practices: Achieving Global Excellence, 3edition, Wiley Publications, 2013
- 2. George Ritz, Sidney Levy, Project Management in Construction, Sixth Edition, Mc. Graw Hill Education. 2011.

### (9 HOURS)

#### (9 HOURS)

- 3. Gary Heerkens, Project Management, Second Edition, Mc. Graw Hill Education, 2013
- 4. P.Gopalakrishnan and V.E.Rama Moorthy Text Book of Project Management,1<sup>st</sup> Edition, Macmillan India Ltd., New Delhi, 2014.
- 5. John M. Nicholas, Herman Steyn, Project Management for Engineering, Business and Technology, 5<sup>th</sup> Edition, Routledge, 2016.

HSS18R005STRESS MANAGEMENT AND COPING STRATEGIES					С	
					3	
Pre requisite: NIL Course Category: Humanities						
Course Type: Theory						

#### **COUSE DESCRIPTION**

Stress has become an integral part of every professional's life. Approaching the stress in the right manner has become imperative as it has become an unavoidable one. The stress and its effect over performance has also become notable in today's organization. In order to cope well and to sustain in market, for that the skills are required to understand and to overcome the same. This course helps in understanding the intricacies of stress and overcoming the stress through appropriate approaches.

#### **COURSE OUTCOMES**

S.NO	DESCRIPTION
CO1	The students understand the responsibility of tackling stress
CO2	The students identify and modify the approaches of stress accordingly while dealing with team in workplace.
CO3	Those students who are prone to face high- pressure working conditions will be in a position to tackle stress appropriately without ignoring.
CO4	The students will implement a stress -free work environment.
CO5	The students will enrich their way of behavior and personality as a whole and ensure professional working condition and balanced quality of life.

Mapping of Course Outcome(s):												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		М										
CO2			Μ									
CO3												
CO4												
CO5												

**UNIT I - UNDERSTANDING STRESS** 

Meaning - Symptoms: Biological and Behavioural - Work Related Stress - Individual Stress - Reducing Stress - Burnout.

UNIT II - COMMON STRESS FACTORS TIME

Common Sources of Stress Biological, Personality and Environmental – Time Management – Techniques – Importance of planning the day – Time management schedule – Developing concentration – Organizing the Work Area - Prioritizing – Beginning at the start – Techniques for conquering procrastination – Sensible delegation – Taking the right breaks – Learning to say 'No'.

# **UNIT III - CRISIS MANAGEMENT**

Implications – People issues – Structure issues, environmental issues, psychological fall outs – Learning to keep calm – Preventing interruptions – Controlling crisis – Importance of good communication – Taking advantage of crisis – Pushing new ideas – Empowerment

#### **UNIT IV - WORK PLACE HUMOUR**

Developing a sense of Humour – Learning to laugh, role of group cohesion and team spirit, using humour at work, reducing conflicts with humour. Coping Styles Defensive Behaviours and Problem-Solving.

### UNIT V - SELF DEVELOPMENT

Improving Personality – Leading with Integrity, enhancing creativity – Effective Decision Making – Sensible Communication – The Listening Game – Managing Self - Meditation for Peace – Yoga for Life.

# TEXT BOOKS

- 1. D. Girdano and G. Everly., "Controlling Stress and Tension", 9 th Edition, Prentice-Hall, 2013.
- 2. Greenberg Jerrold S., Comprehensive Stress Management, 14th Edition, McGraw Hill Education, 2017.

# **REFERENCES**

- 1. Dr.P.K.Dutta, "Stress Management" Himalaya Publishing House, First Edition 2010.
- 2. Schafer, Stress Management, 4th Edition, Cengage Learning, Delhi, 2008
- **3.** Wolfgang Linden, Stress Management, Sage Publication, 1<sup>st</sup> Edition 2005.
- 4. Daniel Girdano, Dorothy Dusek and George S. Everly, Controlling Stress and Tension, 8<sup>th</sup> Edition, Pearson Education, 2009.
- 5. Brian Luke Seaward, Essentials of managing Stress, 1<sup>st</sup> edition, Jones & Bartlett Publishers, 2013.

HSS18R006ENGINEERING ECONOMICS	L	Т	Р	Credit
	3	0	0	3
Pre requisite: NIL	Course Category: H	umani	ties el	ectives
Course Type: Theory				
Course Description:				

#### (9 HOURS) ad team spirit.

(9 HOURS)

### (9 HOURS)

### (9 HOURS)

9 HOURS)

This course provides an introduction to a broad range of economic concepts, theories and analytical techniques. It considers both microeconomics - the analysis of choices made by individual decision-making units (households and firms) - and macroeconomics - the analysis of the economy as a whole. Demand and market structure will be analysed at the firm level. Macroeconomic issues regarding National Income, Inflation, labour and money at an aggregate level will be modelled. The role of government policy to address microeconomic market failures and macroeconomic objectives will be examined.

#### **Course Outcomes:**

The students will be able to

CO 1. Identify and learn economic concepts into market economies.

**CO 2.** Understand the pricing methods, interpret the market factors to determine the price for products or services and to making decisions based on demand factors.

**CO 3.** Understand the major characteristics of different market structures and the implications for the behavior of the firm.

**CO 4.** Measure living standards, inflation, and unemployment for use as economic indicators. Understand the role of international trade,

**CO 5.**Analyze the determinants of the relative strengths of monetary policy for sustainable growth of our nation and International Trade.

Mapp	Mapping of Course Outcome(s):											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Μ											
CO2		М										
CO3		М										
CO4												
CO5									Μ			

### **UNIT I: DEFINITION AND SCOPE OF ECONOMIC**

#### (9 HOURS)

Definitions by A. Smith, A. Marshal and L. Robbins, P.Samuels on and their critical examination - Nature and scope of Economics - Micro-economics in relation to other branches of Economics.

#### **UNIT : II PRICING AND LAW OF DEMAND**

Demand, Factors influencing demand, Elasticity of demand - price, income and cross, concepts and measurement - Break Even Analysis – Law of Demand - Price, income and substitution effects - Giffen goods- Pricing Methods.

#### **UNIT III: MARKET STRUCTURE**

Definition of market. Concepts of product and factor markets. Different types of market: perfect competition, monopoly, imperfect competition, monopolistic, competition and oligopoly.

#### (9 HOURS)

Demand and Supply schedules. Price determination under perfect competition in long and short run. Price determination under monopoly. Discriminating monopoly.

# UNIT IV: MACRO-ECONOMIC

Meaning, Macro-economic Policy and Its Objectives and Instruments - National Income and Social Accounting - Concepts, components, and measurement - Basic circular flow of income model, Unemployment, trade cycle, Inflation - causes, types, effects and control.

# UNIT V: COMMERCIAL AND CENTRAL BANKS

Credit creation, monetary policy and tools - Balance of payments - Items in the balance of payments account, equilibrium in the balance of payments.

# TEXT BOOKS

- 1. Gupta, S.B., Monetary Economics, S. Chand & Co., New Delhi, 2<sup>nd</sup> Edition, 2009.
- 2. RuddarDatt and K.P.M.Sundharam, Indian Economy, 70<sup>th</sup> Edition, S.Chand& Company Ltd., New Delhi, 2013.

### **REFERENCES**

- 1. D.N.Dewedi, Managerial Economics, 8th Edition, S.Chand& Company Ltd., New Delhi, 2005.
- 2. Gupta, G.S. Macroeconomics, Theory and Applications, 2<sup>nd</sup> edition, Tata McGraw-Hill publishing company Ltd., New Delhi, 2004.
- 3. Macroeconomic –Theory and policy, 3<sup>rd</sup> Edition, Tata McGraw-Hill publishing company Ltd., New Delhi, 2010.
- 4. Micro Economics, Mas Colell, 1<sup>st</sup> edition, Oxford Press, Delhi, 2012.

HSS18R007HUMAN RESOURCE MANAGEMENT AND LABOUR	L	Τ	Р	С			
LAW	3	0	0	3			
Pre requisite: NIL Course Category: Humanities electives							
Course Type: Theory							

### **Course Description:**

This course aims at exploring key issues related to the management, performance, and development of human resources in the workplace. It places special emphasis on making decisions and developing plans that will enable managers to make the best possible use of their human resources, and covers areas such as: manpower planning, analysis and evaluation, recruitment and selection, wages and salaries, training and management development, performance appraisal, and industrial relations.

#### **Course Outcomes:**

CO's	Course Description									
CO1	To provide the basic knowledge on developing the employment relations and									
	knowledge to resolve the issues.									
000	To design an appropriate and suitable role of HR specialist for implementing									
02	Human Resource Management policies.									
CO3	To Manage the manpower to motivate and attract them to retain in the									

#### (9 HOURS)

organization.	
To Develop the responsibility of employer and legal system to manage	the
employment relations	
To Provide more insights on the applicability of business law on various function	onal
domains this in turn enhances a strong human relation.	

## Mapping of Course Outcome(s):

	-											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2				М								
CO3												
CO4												
CO5										М		

#### **UNIT – I FUNDAMENTALS OF HRM**

Human Resource Development Systems-HR environment in India-Functions and Operations of a Personnel Office - Emerging HR Trends - HR information system

### **UNIT – II HRM FUNCTIONS**

Job analysis and job design - HR planning - Recruitment - selection and induction- Staff Training and Development-Career planning and Development- Job Evaluation-Performance Appraisal and Potential Evaluation-Wage determination; salary structure-Wage policies and **Regulations-Employee benefits and services** 

### **UNIT – III MOTIVATING HUMAN RESOURCES**

Team and Team work - Collective Bargaining Employee Morale – Participative Management – Quality Circle – Empowerment –counselling and mentoring.

### **UNIT – IV MAINTENANCE OF WORKERS**

Compensation Management- Reward system – Labour relations – Employee Welfare, Safety and Health – Employee benefits and services – Promotion, Transfers and separation – Ethical issues in HR Management and International Human Resource Management - Legal Aspect of Labour **UNIT – V BUSINESS LAW** (9 HOURS)

Factories Act, 1948 - Industrial Dispute Act, 1947 – Industrial employment – Standing Orders Act, 1946 – Trade Union Act, 1926 - Workmen Compensation Act, 1923, Employees State Insurance Act, 1948, Employees Provident Fund and Miscellaneous Provision Act, 1952, Payment of Gratuity Act, 1972. Payment of Wages Act 1936, Minimum wages Act, 1948-Payment of Bonus Act, 1965. Tamil Nadu Shops and Establishments Act.

### **TEXT BOOKS**

- Decenzo and Robbins, Human Resource Management, Wilsey, 12<sup>th</sup> edition, 2015. 1.
- Prasad L.M., Human Resource Management, 3<sup>rd</sup> edition, Sultan Chand, New Delhi, 2014. 2. **<u>REFERENCES</u>**
- 1. BiswajeetPattanayak, Human Resource Management, 3<sup>rd</sup> edition, Eastern Economy Edition, New Delhi, 2010.

# 120

### 9 HOURS)

(9 HOURS)

(9 HOURS)

- 2. C.B. Gupta, Human Resource Management, 13<sup>th</sup> Edition, Sultan Chand, New Delhi 2011.
- 3. V.S.P. Rao, Human Resource Management, 3<sup>rd</sup> edition, Excel Books, New Delhi, 2010.
- 4. Frank B. Cross and Roger LeRoy Miller, The Legal Environment of Business Text and cases, 9<sup>th</sup> Edition, Cengage Learning, 2015

HSS18DAA8ENTDEDDENELIDSHID DEVELODM	L	Т	Р	Credit		
HSSI6KUU8EN I KEPKENEUKSHIP DEVELOPMEN I				0	3	
Pre requisite: NIL	Course Category: Humanities electives					
Course Type: Theory						

#### **Course Description:**

This course focuses on the entrepreneurial process and the different kinds of entrepreneurial outcomes. Topics covered include opportunity identification through analysis of industry niches, skills needed in order to turn an opportunity into reality, business plans, launch decisions, and obtaining risk capital. This course deals with the problems and challenges facing the management of businesses in raising funds, marketing products and services, improving effectiveness and flexibility, and achieving growth.

#### **Course Outcomes:**

CO's	Course Outcomes
	It provides more insights into the concept of entrepreneurship and which in turn
CO1	leads to think creatively for new business opportunities to sustain individual as well
	as social goals.
CO2	It provides and promotes entrepreneurial spirit and provides a framework of
	successful business world with relation to agencies to promote employment
	opportunities.
CO3	It focuses on women entrepreneurship and promotes a successful business models
005	and explains operational implementations for investment details.
COA	It provides the role of government in promoting the entrepreneurship among the
004	individuals and organizations as a whole
CO5	To Understand emerging concepts of marketing in the emerging global markets and
005	provide more insights into project management and venture promotion

Mapp	ing of (	Course	Outcon	ne(s):								
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2									М			
CO3									М			
CO4												
CO5		М										

UNIT – I INTRODUCTION

122

Concepts of entrepreneur, entrepreneurship and entrepreneur - Characteristics and competencies of a successful entrepreneur - General functions of an entrepreneur - Type of entrepreneurs - Role of entrepreneur in economic development - Distinction between an entrepreneur and a manager - Entrepreneur and Intrepreneur.

# UNIT – II GROWTH OF ENTREPRENEURSHIP

Emergence of entrepreneurship - Economic and non economic factors for stimulating entrepreneurship development - Obstacles to entrepreneurship development in India - Growth of entrepreneurship in India.

# UNIT – III WOMEN AND ENTREPRENEURSHIP

Concept of women entrepreneurship - Reasons for growth of woman entrepreneurship - Problems faced by them and remedial measures.

# UNIT – IV ROLE OF THE GOVERNMENT IN ENTREPRENEURSHIP DEVELOPMENT

# (9 HOURS)

Concept and meaning of entrepreneurship development - Need for entrepreneurship development programmes (EDPs) - Objectives of EDPs - Organizations for EDPs in India; NIESBUD, SISI – their roles and activities.

# **UNIT – V VENTURE PROMOTION AND PROJECT FORMULATION**

### (9 HOURS)

Concept of projects classification of projects and project report - Project identification and selection - Constraints in project identification - Techniques of Project Identification, Significance – contents - formulation of project report - Need for Project Formulation - Elements of project Formulation

# TEXT BOOKS

- 1. Michael H Morris, Corporate Entrepreneurship and Innovation in Corporations, 7<sup>th</sup> Edition, CENGAGE Learning, Delhi, 2010
- 2. Jerry Katz, Entrepreneurship Small Business, 5<sup>th</sup> edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007.

# **REFERENCES**

- 1.Khanka S.S., Entrepreneurial Development, 1<sup>st</sup> edition, S.Chand and Company Limited, New Delhi, 2013.
- 2.Prasama Chandra, Projects: Planning, Analysis, Selection, Implementation and Reviews, 2<sup>nd</sup> edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1996.
- 3.Robert D. Hisrich, Entrepreneurship, 10<sup>th</sup> edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017

HSS18D000COST ANALVSIS AND CONTROL		L	Т	Р	Credit
IISSIGROUPCOST ANALISIS AND CONTROL		3	0	0	3
Pre requisite: NIL	<b>Course Categor</b>	<b>y։</b> Hւ	ımani	ties el	ectives

# (9 HOURS)

#### Course Type: Theory

### **Course Description:**

This course in meant to exhibit the concepts on costing by describing its elements, types and cost sheet preparation. It also encompasses the analytical framework that can be applied in cost analysis like Marginal costing, CVP analysis, Break even analysis, etc enabling the students to make decisions on cost parameters. Students are enabled to apply techniques like standard costing, activity based costing, etc to manage and control cost effectively.

#### **Course Outcomes**

CO1	Understand the basics of Costing and preparation of Cost sheet.
CO2	Analyse the cost by applying tools like Marginal costing, CVP analysis and other applications.
CO3	Enabled to use Budgets for controlling cost in Manufacturing or Production Centres.
CO4	Defining cost standards and critically examining the application of Standard costing in a Production Centre.
CO5	Understanding the application of various strategic cost alternatives including Activity based costing.

# Mapping of Course Outcome(s):

			0 4000									
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		М										
CO2	М											
CO3												
CO4									М			
CO5		М										
UNIT I INTRODUCTION TO COSTING (9 HOURS											OURS)	

### **UNIT I INTRODUCTION TO COSTING**

Costing, Elements of costing, Types of cost, Preparation of cost sheet.

### **UNIT II COST ANALYSIS**

Marginal costing, Cost - volume - Profit analysis, Break-Even- Analysis, Break - Even - Chart, Applications.

# **UNIT III CONTROL TECHNIQUES**

Budgeting and Budgetary control, Types of Budgets, Preparation of purchase Budget, Flexible budgets, Cash Budget, Sales Budget, Materials Budget, Master Budget, Zero based Budgeting. UNIT IV STANDARD COSTING (9 HOURS)

Types of Standards, Setting up of standards, Advantages and Criticism of Standard Costing – Control through variances.

# 123

### (9 HOURS)

# **UNIT V ACTIVITY BASED COSTING**

Transfer Pricing, Target costing, Life Style Costing, Activity Based Costing (only theory). **TEXT BOOKS** 

- 1. K.Saxena& C.D. Vashist, Advanced Cost Accounting and Cost Systems, 2<sup>nd</sup> Edition, V.Sultan Chand & Sons Publishers. 2014
- 2. S.P. Jain & K. L. Narang, Advances Cost Accounting Kalyani Publishers, 1<sup>st</sup> Edition, 2017.

# **REFERENCES**

- 1. J. Blocher, K. H. Chen, G. Cokins and T. W. Lin., Cost Management: A Strategic Emphasis, Irwin/McGraw-Hill, 3d edition, 2008
- 2. Don R. Hansen, Maryanne M. Mowen, Cornerstones of Cost Management, 6<sup>th</sup>Edition,Cengage Learning, 2015
- 3. Roger Hussey, Audra Ong, Strategic Cost Analysis, Business Expert Press, 2012

HEELODALADDODUCT DESIGN AND DEVELODA	ADNIT	L	Т	Р	Credit
HSSI8RUIUPRODUCT DESIGN AND DEVELOPN	IEIN I	3	0	0	3
Pre requisite: NIL	<b>Course Categor</b>	y: Hu	imani	ties el	ectives
Course Type: Theory					
COURSE OB IECTIVES:					

# COURSE OBJECTIVES:

- 1. To understand the basic characteristics of design of product and its evolution.
- **2.** To be aware of the various approaches related to new product development process.
- 3. The student will learn about the need for industrial design and its impact on the market.
- 4. To gain insights about Failure Mode Effective Analysis.
- 5. To understand the methodologies and tools related to design of new product and the concepts associated to Value engineering.

# **COURSE OUTCOMES**

S.NO	DESCRIPTION
CO1	To learn basic concepts related to design and development of New product
CO2	To understand the structured approach towards incorporating quality, safety, and reliability into design.
CO3	To learn the concepts relating to simulating product performance and manufacturing processes.
CO4	To understand the technologies related to computer aided group technology
CO5	To learn implications of changes related to Economic analysis.

Mapp	Mapping of Course Outcome(s):												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1		М											

CO2	М					
CO3						
CO4	М					
CO5	М					

## UNIT – I NEW PRODUCT IDEA (9 HOURS)

Definition – Design by Evolution and by Innovation - factors to be considered for product design – Production-Consumption cycle – The morphology of design – Primary design Phases and flowcharting. Role of Allowance, Process Capability, and Tolerance in Detailed Design and Assembly Product strategies, Market research – identifying customer needs – Analysis of product – locating ideas for new products, Selecting the right product, creative thinking, curiosity, imagination and brain storming - product specification.

### **UNIT – II NEW PRODUCT DESIGNING**

Task - Structured approaches – clarification – search – external and internal – systematic exploration – conception, selection - methodology benefits. The value of appearance - principles and laws of appearance – incorporating quality, safety, and reliability into design. Man-machine considerations – Designing for ease of maintenance.

#### UNIT – III ROLE OF TECHNOLOGY IN DESIGNING

Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing process – Needs for industrial design-impact – Industrial design process – Technology driven products - user driven products – assessing the quality of the product.

### **UNIT – IV METHODS AND PRINCIPLES OF DESIGNING**

Methodologies and tools - Design axioms - Design for assembly and evaluation - Minimum part assessment - Taguchi Method - Robustness assessment - Manufacturing process rules -Designer's tool kit - Computer aided group process rules - Designer's tool kit - Computer aided group technology - Failure Mode Effective Analysis – Design for minimum number of parts – Development of modular design – Minimising part variations – Design of parts to be multifunctional, multi-use, ease of fabrication – PokaYoka principles. (12 hours)

### **UNIT – V FEASIBILITY ANALYSIS**

Estimation of manufacturing cost – cost procedures – Value Engineering - reducing the component cost and assembly cost – minimizing the system complexity – Basics and Principals of prototyping – Economic Analysis: Break even analysis. Classes of exclusive rights – Patents – Combination versus aggregation – Novelty and Utility – Design patents – Paten disclosure – Patent application steps - Patent Office prosecution - Sales of patent rights - Trademarks – copy rights. (12 hours)

### TEXT BOOKS

- 1. Karl.T.Ulrich, Steven D.Eppinger, Product Design and Development, McGraw Hill International, 6th Edition, 2016.
- 2. A.K.Chitale and R.C.Gupta, Product Design and Manufacturing, 3<sup>rd</sup> edition, Prentice Hall of India Private Limited, New Delhi, 2005.

### **REFERENCES**

# (9 HOURS)

(9 HOURS)

(9 HOURS)

- 1. Richard Crowson, Product Design and Factory Development, 2<sup>nd</sup> Edition, crc Press, 2005.
- 2. Thomke, Stefan, and Ashok Nimgade. "IDEO Product Development." Boston, MA: Harvard Business School Case 9-600-143, June 22, 2000.
- 3. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill Higher Education, 4th Edition, 2012.
- 4. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2004, Pearson Education

HSS18D011BUSINESS BDOCESS DEENCINEEDI	NC	L	Т	Р	Credit
IISSI6KUIIDUSINESS I KOCESS KEENGINEEKI	IIG	3	0	0	3
Pre requisite: NIL	<b>Course Categor</b>	y: Hu	ımani	ties el	ectives

Course Type: Theory COUSE DESCRIPTION:

- This course aims to clarify the principles and basic concepts of Business Process Engineering.
- This course focuses on both quantitative and qualitative analytical skills and models essential to operations process design, management, and improvement in both service and manufacturing oriented companies. The main objective of the course is to prepare the student to play a significant role in the management of a world class company which serves satisfied customers through empowered employees, leading to increased revenues and decreased costs.

# **COURSE OUTCOMES**

S.NO	DESCRIPTION
CO1	To learn the basic concepts related to Business Process Reengineering.
CO2	To understand the methodologies and tools used for Business Process Reengineering.
CO3	To learn the concepts relating to benefit/cost analysis and its impact on the business organizations.
CO4	To understand the need for assessment of business re-engineering and the factors contributing to its success.
CO5	To learn the best practices used in Business Process Reengineering with illustrations from corporate world.

Mapp	ing of C	Course	Outcon	ne(s):								
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2		М										
CO3		М										

CO4					М		
CO5						Μ	

# **UNIT – I BASIC CONCEPTS**

Introduction to BPR Definition; the paradigm shifts in production; the positioning concept; the re-engineering visions; the benefits of business re-engineering.

(9 HOURS)

(9 HOURS)

(9 HOURS)

(9 HOURS)

(9 HOURS)

# UNIT – II METHODOLOGIES FOR BPR

Methodologies and Tools for BPR, Process management; dynamic business re-engineering change framework; steps to reengineer the process.

# **UNIT – III MODELLING THE BUSINESS**

Tools used in Modelling the Business: flow-charting, business activity maps, relational diagrams, benefit/cost analysis. The enabling role of information technology in business re-engineering.

# **UNIT – IV CHANGE MANAGEMENT**

Change Management, Planned changes in business re-engineering projects; challenges of business change; business change development. Success factors in re-engineering. The assessment of business re-engineering.

# **UNIT- V BEST PRACTICES IN BPR**

Best Practices in BPR, Case studies: Bell Atlantic, Nissan, Chrysler, Xerox, and Hewlett Packard etc.

# **TEXTBOOKS**

- 1. Ali K. Kamrani, Maryam Azimi (2011). New Methods in Product Design: New Strategies in Reengineering (Engineering and Management Innovation). CRC Press. 1<sup>st</sup> ed.
- 2. Bassam Hussein (2008). PRISM: Process Reengineering Integrated Spiral Model. VDM Verlag Dr. Mueller e.K.

# **REFERENCES**

1. Harmon, P. (2007), Business Process Change : A Guide for Business Managers and BPM and Six Sigma Professionals, Elsevier/Morgan Kaufmann Publishers.

2. R. Anupindi et al. (2006), Managing Business Process Flows: Principles of Operations Management, Pearson Education Inc.

HSS18R012POLITICAL ECONOMY	L	Τ	P	Credit			
	3	0	0	3			
Pre requisite: NIL Course Cat	egory: H	<b>gory:</b> Humanities electives					
Course Type: Theory							

# **Course Description**

This course provides an introduction to the political economy of India. It examines the interplay of politics and economics. Some of the key themes to be explored are globalization, economic reform, poverty, redistribution, federalism, political protest, public goods delivery, gender, and

ethnic politics. Although this class focuses specifically on India, a number of the themes discussed in this course are functions of institutions, rights, Party Systems and challenges.

#### **COURSE OUTCOMES**

The students will be able to

S.NO	DESCRIPTION
CO1	Explain the key concepts of political economy analyse the significant developments in the political ideologies.
CO2	Describe the salient features of the constitution of India and its functions and also interpret, integrate and critically analyse the fundamental rights duties and responsibilities.
CO3	Understand the Political party system their evolution and role in the economy
CO4	Understand the various ideological of Indian Political Thoughts
CO5	have a deep understanding and appreciation of India undergoing major economic and social transformation

Mapp	Mapping of Course Outcome(s):												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	Μ												
CO2													
CO3		М											
CO4		М											
CO5									М				

### **UNIT I -INTRODUCTION TOPOLITICAL ECONOMY**

#### (9 HOURS)

(9 HOURS)

(9 HOURS)

(9 HOURS)

Political Economy as a Method, perspectives, Politics as Reproduction of Social Relations, State and Social Opportunity, Politics of Rent Seeking -Evolution of State in India: Historical Roots of planning, Redistribution.

### **UNIT II - INDIAN CONSTITUTION**

The Pre-ample- Fundamental rights and duties, Directive Principles- Offices of the President, Prime Minister, Cabinet Government, Chief Election Commissioner, and Governor – Parliamentary system and Procedures - The Judiciary system.

### **UNIT III - PARTY SYSTEM**

National and regional political parties, ideological and social bases of parties; patterns of coalition politics; Pressure groups, trends in electoral behaviour; changing socio- economic profile of Legislators.

# UNIT IV - INDIAN POLITICAL THOUGHT:

Political Ideologies: Liberalism, Socialism, Marxism, Fascism, Gandhism and Feminism - Dharamshastra, Arthashastra and Buddhist traditions; Sir Syed Ahmed Khan, Sri Aurobindo, M.K. Gandhi, B.R. Ambedkar, M.N. Roy.

# UNIT V - CHALLENGES TO INDIAN DEMOCRACY (9 HOURS)

Uneven Development of Regions in India – Communalism – Regionalism – Violence – Corruption – environmental degradation- illiteracy –Population.

## TEXT BOOKS

- 1. Charles Sackrey, Geoffrey Schneider, Janet Knoedler, Introduction to Political Economy, Dollars & Sense, 8<sup>th</sup> Edition, 2016.
- 2. Robert.S.Dimand, Review of Political Economy: An Introductory Text, 1<sup>st</sup> Edition, Routledge, 2008.

# **REFERENCES**

- 1. Barry R. weingast and Donald a.Wittman, Handbook of Political Economy, 1<sup>st</sup> Edition, Oxford University Press, New York, 2006.
- 2. Ed. Sanjay Ruparelia; Sanjay Reddy; John Harriss& Stuart Corbridge, Understanding India's New Political Economy: A Great Tranformation, Routledge 1<sup>st</sup> Edition edition 2011.
- 3. M.Laxmikanth, Indian Polity, 4<sup>th</sup> Edition, McGraw Hill Education, New Delhi,2017.
- 4. Niraja Gopal Jayal, Pratap Bhanu Mehra, The Oxford Companion to Politics in India: Student Edition, Oxford Press, 2011.

1100100012	BDOFESSIONAL ETHICS	L	Т	Р	Credit		
H5518K015	PROFESSIONAL ETHICS	3	0	0	3		
Pre requisite: NIL	uisite: NIL Course Category: Humanities elec						
Course Type: Theory							

# **COUSE DESCRIPTION:**

It is essential for professionals in any field to have an understanding of the ethical problems and principles in their field. The general principles of professional ethics will be examined, as well as the distinctive problems. This course is presented in three parts: theory; case studies; and research and presentation. Theory includes ethics and philosophy of engineering. Historical cases are taken primarily from the scholarly literatures on engineering ethics, and hypothetical cases are written by students. It will allow students to explore the relationship between ethics and engineering and apply classical moral theory and decision making to engineering issues encountered in academic and professional careers.

### **COURSE OUTCOMES**

S.NO	DESCRIPTION
CO1	identify the multiple ethical interests at stake in a real-world situation or practice
CO2	assess their own ethical values and the social context of problems

CO3	Develop critical thinking skills and professional judgement and understand practical difficulties of bringing about change
CO4	demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work
CO5	Manage differing opinions on complex ethical scenarios. It's important for those confronted with ethical challenges to be able to hold multiple conflicting points of view, without necessarily adhering to any of them.

Mapp	ing of (	Course	Outcon	ne(s):								
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Μ											
CO2												
CO3		М										
CO4												
CO5									М			

#### **UNIT I - ENGINEERING ETHICS**

1

Functions of Being a Manager – Stock holder and stakeholder management – Ethical treatment of employees - ethical treatment of customers- supply chain management and other issues.

#### **UNIT II - ENGINEERING AS SOCIAL EXPERIMENTATION** (9 HOURS) Senses of Ethics - Variety of moral issues - Types of inquiry - Moral dilemmas - Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism - Professional ideals and virtues - Theories about right action - Self-interest - Customs and religion - Use of Ethical Theories.

#### **UNIT III - ENGINEER RESPONSIBILTY FOR SAFETY** (9 HOURS)

Corporate social responsibility - Collegiality and loyalty - Respect for Authority - Collective Bargaining - Confidentiality - Conflicts of Interest - Occupational Crime - Professional Rights - Employee Rights - Discrimination.

#### **UNIT IV - RESPONSIBILITY AND RIGHTS**

Moral imagination, stake holder theory and systems thinking - One approach to management Decision – making Leadership.

### **UNIT V - GLOBAL ISSUES**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development - Engineers as Managers - Consulting Engineers - Engineers as Expert Witnesses and Advisors - Moral Leadership - Sample code of conduct.

### **TEXT BOOKS**

1. Mike Martin and Roland Schinzinger, Introduction to Engineering Ethics, 2nd Edition, McGraw Hill Higher Education, New Delhi, 2010.

# 130

# (9 HOURS)

# (9 HOURS)

2. Charles D Fledderman, Engineering Ethics, 4<sup>th</sup> Edition, Pearson Education, Delhi, 2011. **<u>REFERENCES</u>** 

- 1. R.S.Naagarazan, Text book on Professional Ethics and Human Values, New Age International, 2007.
- 2. Gail Baura, Engineering Ethics- An Industrial Perspective, 1<sup>st</sup> Edition, Academic Press, 2006.
- 3. Charles e. Harris , Michael s. Pritchard and Michael J. Rabins Texas , Engineering Ethics-Conecpts and Cases, 4<sup>th</sup> Edition, Cengage Learning, 2009.
- 4. Charles BymsFleddermann, Engineering Ethics, 3<sup>rd</sup> Edition, Pearson Prentice Hall, 2008.
- 5. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2013.
- 6. Dr.V.Jeyakumar, Professional Ethics in Engineering, Lakshmi Publication, Chennai, 2014.

11CC10DA1/	ODED ATIONS DESEADCH	L	Т	Р	Credit
H5518K014	OPERATIONS RESEARCH	3	0	0	3
Pre requisite: NIL	Course Categor	y: Hu	ımani	ties el	lectives
Course Type Theory					

# **COUSE DESCRIPTION:**

This subject will provide students withability to understand and analyze managerial problems in industry so that they are able to use resources (capitals, materials, staffing, and machines) more effectively. It also provides the knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry. It enhances the skills in the use of Operations Research approaches and computer tools in solving real problems in industry.

# **COURSE OUTCOMES**

• •

The students will be able to

S.NO	DESCRIPTION
CO1	to identify and develop operational research models from the verbal description of the real System.
CO2	Be able to build and solve Transportation Models and Assignment Models
CO3	Use mathematical software to solve the proposed models.
CO4	Develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decision making processes in Management Engineering.
CO5	Be able to design new simple models, like: CPM, MSPT to improve decision –making and develop critical thinking and objective analysis of decision problems.

Mapping of Course Outcome(s):												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	М							
CO2								
CO3		М						
CO4					М			
CO5						М		

# **UNIT I - INTRODUCTION TO LINEAR PROGRAMMING**

#### (9 HOURS)

Introduction to applications of operations research in functional areas of management - Linear Programming - formulation, solution by graphical and simplex methods (Primal - Penalty, Two Phase), Special cases - Dual simplex method.

# UNIT II - TRANSPORTATION MODELS AND ASSIGNMENT MODELS (9 HOURS)

Transportation Models (Minimising and Maximising Cases) – Balanced and unbalanced cases – Initial Basic feasible solution by N-W Corner Rule, Least cost and Vogel's approximation ethods - Check for optimality - Solution by MODI / Stepping Stone method - Cases of degeneracy -Transshipment Models - Assignment Models (Minimising and Maximising Cases) – Balanced and Unbalanced Cases - Solution by Hungarian and Branch and Bound Algorithms - Travelling Salesman problem - Crew Assignment Models.

# UNIT III - INTEGER LINEAR PROGRAMMING AND GAME THEORY (9 HOURS)

Solution to pure and mixed integer programming problem by Branch and Bound and cutting plane algorithms - Game Theory - Two person Zero sum games - Saddle point, Dominance Rule, graphical and LP solutions.

# UNIT IV - REPLACEMENT MODELS AND DECISION THEORY(9 HOURS)Replacement Models-Individuals replacement Models (With and without time value of money) –

Group Replacement Models - Decision making under risk – Decision trees – Decision making under uncertainty.

# UNIT V - PROJECT MANAGEMENT METHOD AND SIMULATION (9 HOURS)

PERT / CPM – Drawing the network, computation of processing time, floats and critical path. Resource leveling techniques - Application of simulation techniques for decision making.

# TEXT BOOKS

- 1. Kalavathy S, Operations Research, Vikas Publishing House, 4<sup>TH</sup> Edition, 2013.
- 2. Paneerselvam R., Operations Research, Prentice Hall of India, 2<sup>ND</sup> Edition, 2006.
- 3. Tulsian P.C, Vishal Pandey, Quantitative Techniques (Theory and Problems), Pearson Education, Asia, First Indian Reprint 2002.

### **REFERENCES**

- 1. D.S.Hira, Problems in Operations Research, Kindle Edition, S.Chand, 2010.
- 2. Prem Kumar Gupta and D.S. Hira, Operations Research, S.Chand, 2016.
- 3. R.C.Mishra, Principles of Operations Research, 1st Edition, New Age International 2011.
- 4. Kanti Swarup, P.K.Gupta and Man Mohan, Operations Research, 15<sup>th</sup> Edition, Sultan Chand and Sons 2010

1100100015		L '	Т	Р	Credit
HSS18K015	TUTAL QUALITY MANAGEMENT	3	0	0	3

# Pre requisite: NIL

Course Category: Humanities electives

**Course Type**: Theory

# **COUSE DESCRIPTION:**

This subject provides students with the knowledge to understand the philosophy and core values of Total Quality Management (TQM). It helps to determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization; apply and evaluate best practices for the attainment of total quality. Students who complete this course will be able to critically appraise management techniques, choose appropriate statistical techniques for improving processes and write reports to management describing processes and recommending ways to improve them.

# **COURSE OUTCOMES**

S.NO	DESCRIPTION						
CO1	Understand the role and nature of quality in evolving international economic conditions						
CO2	Apply the Principles of Quality Management for real time problems.						
CO3	the quality encounter process, including supporting facilities and customer requirements/characteristics						
CO4	Classify quality measurement methods and continuous improvement process						
CO5	Frame Management strategy methods, including identification, development, implementation and feedback processes						

Mapping of Course Outcome(s):												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	М											
CO2		М										
CO3									М			
CO4												
CO5										М		
UNIT I - INTRODUCTION TO QUALITY MANAGEMENT (9 HOURS)												

Definitions – TOM framework, benefits, awareness and obstacles - Quality – vision, mission and policy statements - Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality. UNIT II - PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT (9 HOURS) Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi, Shingeo and Walter Shewhart - Concepts of Quality circle, Japanese 5S principles and 8D methodology.

# UNIT III - STATISTICAL PROCESS CONTROL AND PROCESS CAPABILITY

# (9 HOURS)

Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed - Process capability – meaning, significance and measurement – Six sigma concepts of process capability - Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve - Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

# UNIT IV - TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT

# (9 HOURS)

Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation. UNIT V -TAGUCHI TECHNIOUES (9 HOURS)

Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio - Seven old (statistical) tools - Seven new management tools - Bench marking and POKA YOKE.

# TEXT BOOKS

- Poornima M.Charantimath., Total quality management, Pearson Education, 2<sup>ND</sup> Edition, 2011.
- **2.** Dale H.Besterfield et al, Total Quality Management, Perarson Education, Thrid edition, (First Indian Reprints 2004).

# **REFERENCES**

- 1. Shridhara Bhat K, Total Quality Management Text and Cases, Himalaya Publishing House, First Edition, 2002.
- 2. Jams R. Evans, Total Quality: Management, Organisation and strategy, 4<sup>th</sup> Edition, South-Western College, 2004.
- 3. Vincent K.Omachonu, Joel E.Ross, Principles of Total Quality, 3<sup>rd</sup> Edition, CRC Press, 2004.
- 4. S.Rajaram, M.Sivakumar, Total Quality Management, Wiley Publishers, 1<sup>st</sup> Edition, 2008.

HSS18D 016 ADVANCED SOFT SKILLS	L	Т	Р	Credit
IISSION OID AD VANCED SOF I SKILLS	3	3 0 0		3
Pre requisite: NIL	Course Category: H	umani	ties el	ectives
Course Type: Theory				
FEFECTIVE COMMUNICATION				

EFFECTIVE COMMUNICATION

Comprehending Ability, Business Vocabulary, Speed Reading, Non-Verbal Communication, Cross Cultural Communication, Meeting Management, Technology trend awareness

# **QUANTITATIVE ABILITY**

Time & Work, Time-Speed-Distance, Permutation & Combination Probability, Geometry & Mensuration, Number Properties, Ratio & Proportion, Mixtures & Alligation, Percentages, Profit-Loss-Discount, Averages, Progression, Higher Mathematics

# LOGICAL ABILITY

Non-Verbal Reasoning, Deductive & Inductive Reasoning, Binary Logic, Number Series, Clocks, Calendars

#### VERBAL ABILITY

Reading Comprehension, Parajumbles, Critical Reasoning, Subject-Verb Agreement, Synonyms & Antonyms, Grammar Reading Comprehension & Logic Miscellaneous Verbal questions

# DATA INTERPRETATION

Line Charts, Bar Charts, Pie Charts, Venn diagrams, Caselets, Data tables.

- I (HSS18R101)						
S. NO	UNIT	TOPICS	DURATION	CONSOLIDATED		
		Listening : Focus	2 hours			
		Listening : Intuition about the speaker	2 hours			
	FFFCTIVE	Listening : Critical Listening	4 hours			
1	COMMUNICATION	Writing : Reports	2 hours			
		Writing : E-mail	2 hours			
		Writing : Book & Movie Review	2 hours	24 hours		
		Writing : Notices & Advertisements	2 hours			
		Speaking : Introducing Self	2 hours			
		Speaking : Just - a - Minute	2 hours			
		Speaking : Ad Zap	2 hours			
		Speaking : Story Telling	2 hours			
	QUANTITATIVE ABILITY	Introduction to Numerical Skills	2 hours			
2		Introduction to Logical Skills	2 hours	6 hours		
		Vedic Mathematics	2 hours			
	TIME	Prioritisation	2 hours			
3	MANAGEMENT	Procrastination	2 hours	6 hours		
		Multi-Tasking	2 hours			
		Blog Writing	2 hours			
4	SOCIAL MEDIA	LinkedIn	2 hours	6 hours		
		Usage of messaging applications	2 hours			
5	SOFT SKILLS	Importance of Soft Skills	1 hour	3 hours		
		Lateral Thinking	2 hours	5 110015		

- II (HSS18R102)					

S. NO	UNIT	TOPICS	DURATION	CONSOLIDATED
	EFFECTIVE	Reading : Speed Reading techniques	2 hours	
1		Reading : News Story Analysis	2 hours	
1	COMMUNICATION	Presentation : Organising Content	2 hours	12 hours
		Presentation : Use of fonts & animations	2 hours	
		Presentation : Mock Presentations	4 hours	
2	QUANTITATIVE	Number Properties	2 hours	
2	ABILITY	Averages	2 hours	6 hours
		Progression	2 hours	
3	VERBAL ABILITY	Vocabulary Building Techniques	4 hours	6 hours
		Analogy	2 hours	0 110013
4	SOCIAL	Interpersonal Skills	2 hours	
4	INTERACTION	Dealing with difficult people	2 hours	6 hours
		Stress Management	2 hours	
		Begin with the End in Mind	2 hours	
		First things First	2 hours	
5	SOFT SKILLS	Think Win - Win	2 hours	
		Seek first to understand, then to be understood	2 hours	15 hours
		Synergy	2 hours	
		Secret	2 hours	
		Mind Maps	1 hour	
		Creativity	2 hours	

- 3 (HSS18R201)						
S.NO	UNIT	TOPICS	DURATION	CONSOLIDATED		
	EFFECTIVE	Sentence Construction	2 hours			
1	COMMUNICATION	Tenses	2 hours	6 hours		
		Verbal Communication	2 hours			
	OUANTITATIVE	Percentages	2 hours			
2	ABILITY	Profit-Loss-Discount	2 hours			
		Ratio & Proportion	2 hours	12 hours		
		Mixtures & Alligation	2 hours	12 hours		
		Interest Calculations	2 hours			
		Probability	2 hours			
		Data Arrangements	2 hours			
3	LOGICAL ABILITY	Coding & Decoding	2 hours			
		Ranking / Ordering	2 hours	12 hours		
		Venn Diagrams	2 hours	12 110015		
		Syllogisms	2 hours			
		Introduction to Data	2 hours			

		Interpretation		
		Sentence correction	2 hours	
4	VERBAL ABILITY	Sentence Completion	2 hours	
		Idioms & Phrases	2 hours	12 hours
		Articles	2 hours	12 liouis
		Analytical Writing	2 hours	
		Descriptive Writing	2 hours	
5	SOFT SKILLS	Dining Etiquette	2 hours	3 hours
2		Hygiene	1 hour	J HOUIS