VELALAR COLLEGE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

Thindal, Erode - 638 012

(Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai) (Accredited by NAAC with 'A' grade)



REGULATIONS 2022

CURRICULUM AND SYLLABUS

M.E. – BIOMEDICAL ENGINEERING

Choice Based Credit System (CBCS)

	VELALAR COLLEGE OF ENGINEERING AND TECHNOLOGY (Autonomous)
Department	Biomedical Engineering
Programme	M.E. – Biomedical Engineering
Regulations	2022

S No	Course		Credits p	er Semest	ær	Total
5.110	Category	1	2	3	4	Credits
1	FC	04				04
2	PC	17	16			33
3	3 PE 06 06					12
4	RM	3				03
5	OE			03		03
6	EC			08	12	20
7	VC, OC, AC, SC			√		-
Total C	Credits / Sem	24	22	17	12	75

SUMMARY OF CREDIT

FC - Foundation Courses

PC - Professional Core

PE - Professional Elective

RM - Research Methodology and IPR

OE - Open Elective

EC - Employability Enhancement Course (Project, Seminar, Industrial Training, Internship etc.)

VC - Value Added Courses

OC - Online Course

AC - Audit Course

SC - Self Study course



VELALAR COLLEGE OF ENGINEERING AND TECHNOLOGY (Autonomous)

R - 2022

DepartmentBiomedical EngineeringProgrammeM.E. – Biomedical Engineering

	SEMESTER 1											
S.	Course	Course Title	atego ry	H V	ours Veel	s / k	edits	Ma	x. Ma	arks		
INO	Code		Ü	L	Т	Р	Cr	CA	SE	Tot.		
	1	Theory	I		r	r	1		1			
1	122MAT15Advanced Applied MathematicsFC31044060100											
2	22RMT01	Research Methodology and IPR	RM	3	0	0	3	40	60	100		
3	22BPT11	Anatomy and Human Physiology	PC	3	0	0	3	40	60	100		
4	22BPT12	Advanced Bio Signal Processing	PC	3	1	0	4	40	60	100		
5	22BPT13	Biomedical Sensors and Instrumentation	PC	3	0	0	3	40	60	100		
6	22BPT14	Medical Imaging Systems	PC	3	0	0	3	40	60	100		
7		Audit Course	AC	2	0	0	0	100	0	100		
		Practical										
8	22BPL11	Clinical Instrumentation and Design Laboratory	PC	0	0	4	2	60	40	100		
9	22BPL12	Advanced Bio Signal Processing Laboratory	PC	0	0	4	2	60	40	100		
			То	tal (Cred	lits	24					

		SEMESTER 2																															
S.	Course	Course Title	atego ry	Hours / Week		Hours / Week		Hours / Week		Hours / Week		Hours / Week		Hours / Week		Hours / Week		Hours / Week		Hours / Week		Hours / Week		Hours / Week		Hours / Week		Hours /		edits	Ma	x. Ma	ırks
INU	Coue		Ű	L	Τ	P	Cr	CA	SE	Tot.																							
		Theory																															
1	22BPT21	Applied Medical Image Processing	PC	3	0	0	3	40	60	100																							
2	22BPT22	Diagnostic and Therapeutic Equipments	PC	3	0	0	3	40	60	100																							
3	22BPT23	Advanced Biomechanics	PC	3	0	0	3	40	60	100																							
4	22BPT24	Rehabilitation Engineering and Assistive Technology	PC	3	0	0	3	40	60	100																							
5		Professional Elective – 1	PE	3	0	0	3	40	60	100																							
6		Professional Elective – 2	PE	3	0	0	3	40	60	100																							

7		Audit Course	AC	2	0	0	0	100	0	100
		Practical								
8	22BPL21	Advanced Medical Image Processing Laboratory	PC	0	0	4	2	60	40	100
9	22BPL22	Medical Device design Laboratory	PC	0	0	4	2	60	40	100
Total Credits										

		SEMESTER 3								
S.	Course	Course Title	tegory	Hours / Week		Hours / Week		Max. Marks		
INO	Code		Cat	L	Т	Р	Cr	CA	SE	Tot.
		Theory								
1		Professional Elective – 3	PE	3	0	0	3	40	60	100
2		Professional Elective – 4	PE	3	0	0	3	40	60	100
3		Open Elective	OE	3	0	0	3	40	60	100
		Practical								
4	4 22BPL31 Hospital / Biomedical Industry Training EC 0 0 4 2 100 0 100									
5	22BPL32	Project Work I	EC	0	0	12	6	60	40	100
	Total Credits 17									

		SEMESTER 4								
S. N	S. Course Course Title									arks
0	Code		Cat	L	Т	Р	C	CA	SE	Tot.
		Practical								
1	22BPL41	Project Work II	EC	0	0	24	12	60	40	100
			Τα	otal	Cre	dits	12			
	Total Programme Credits									

		PROFESSIONAL ELECT	IVES							
S.	Course	Course Title	tegory	H V	ours Veel	s / k	edits	Ma	x. Ma	arks
NO	Code		Cat	L	Т	Р	Cr	CA	SE	Tot.
Sei	Semester – 2 Professional Elective – 1									
1	22BPE01	Principles of Genetic Engineering	PE	3	0	0	3	40	60	100

2	22BPE02	Physics in Medicine	PE	3	0	0	3	40	60	100
3	22BPE03	Advanced Biomaterials and its Applications	PE	3	0	0	3	40	60	100
4	22BPE04	Bio Statistics	PE	3	0	0	3	40	60	100
5	22BPE05	Ultrasound Principles And Its Medical Applications	PE	3	0	0	3	40	60	100
Se	mester – 2	Professional E	lective	e – 2						
1	22BPE06	Advanced Brain Computer Interface	PE	3	0	0	3	40	60	100
2	22BPE07	Tissue Engineering and Its Applications	PE	3	0	0	3	40	60	100
3	22BPE08	Wearable Devices and Technologies	PE	3	0	0	3	40	60	100
4	22BPE09	Bio MEMS Technology	PE	3	0	0	3	40	60	100
5	22BPE10	Pattern Recognition Techniques and its Applications	PE	3	0	0	3	40	60	100
Se	mester – 3	Professional E	lective	e – 3						
1	22BPE11	Hospital Planning, Organization and Management	PE	3	0	0	3	40	60	100
2	22BPE12	Machine Learning Techniques	PE	3	0	0	3	40	60	100
3	22BPE13	Physiological Modeling Systems	PE	3	0	0	3	40	60	100
4	22BPE14	Hospital Management System	PE	3	0	0	3	40	60	100
5	22BPE15	Health Policy and Equipment Management	PE	3	0	0	3	40	60	100
Se	mester – 3	Professional E	lectiv	e - 4						
1	22BPE16	Computer Based Medical Instrumentation	PE	3	0	0	3	40	60	100
2	22BPE17	Nanoscience and Technology	PE	3	0	0	3	40	60	100
3	22BPE18	Deep Learning Techniques	PE	3	0	0	3	40	60	100
4	22BPE19	Biomedical Optics	PE	3	0	0	3	40	60	100
5	22BPE20	Advanced Neural Computing.	PE	3	0	0	3	40	60	100

	OPEN ELECTIVES													
S.	Course	Course Title	Category	tegory		Hours / Week		Hours / Week		edits	Max. Marks			
INO	Code		Ca	L	Т	Р	Cr	CA	SE	Tot.				
	OFFERED BY DEPARTMENT OF BIO MEDICAL ENGINEERING													
1	22BPO01	Biomedical Waste Management in Hospitals	OE	3	0	0	3	40	60	100				
2	22BPO02	Introduction to Clinical Trials	OE	3	0	0	3	40	60	100				

3	22BPO03	Quality Assurance and Safety in Hospitals	OE	3	0	0	3	40	60	100
4	22BPO04	Telemedicine Technology	OE	3	0	0	3	40	60	100
	OFFERE	ED BY DEPARTMENT OF COMPUTER S	CIEN	CE /	ANI) EN	IGIN	EERI	NG	
1	22CPO01	Principles of Information Security	OE	3	0	0	3	40	60	100
2	22CPO02	Fundamentals of Block Chain	OE	3	0	0	3	40	60	100
3	22CPO03	Big Data Management	OE	3	0	0	3	40	60	100
4	22CPO04	Social Network Analysis	OE	3	0	0	3	40	60	100
OF	FERED BY I	DEPARTMENT OF ELECTRONICS AND	COM	MU	NIC	AT]	ION]	ENGI	NEER	RING
1	22AEO01	Hardware Software Co-Design	OE	3	0	0	3	40	60	100
2	22AEO02	Embedded C	OE	3	0	0	3	40	60	100
	OFFERED B	Y DEPARTMENT OF ELECTRICAL ANI) ELE	CT	RON	VIC	S EN	GINE	ERIN	G
1	22ESO01	Waste to Energy	OE	3	0	0	3	40	60	100
2	22ESO02	Industrial Drives for Automation	OE	3	0	0	3	40	60	100
3	22ESO03	Hybrid Electric Vehicles	OE	3	0	0	3	40	60	100

(Re	AUDIT COURSES (Registration for any of these courses is optional to students, it will be mentioned in the Grade statement. However, it will not be considered for computation of CGPA)												
S.	S. Course Course Title S. Course Title B. Course Title												
INO	Code		Cat	L	Т	Р	Cr	CA	SE	Tot.			
1	22AC01	English for Research Paper Writing	AC	2	0	0	0	100	0	100			
2	22AC02	Disaster Management	AC	2	0	0	0	100	0	100			
3	22AC03	Constitution of India	AC	2	0	0	0	100	0	100			
4	22AC04	Pedagogy Studies	AC	2	0	0	0	100	0	100			

- L Lecture Period
- T Tutorial Period
- P Practical Period

CA - Continuous Assessment SE - Semester Examination

Tot - Total

22MAT15

Preamble

Matrices used to represent the system of equations and we can easily find the characteristics of the system. Fourier transforms used to convert the problem from one domain to another domain. The knowledge of transformations is to create a new domain in which it is easier to handle the problem that is being investigated. Simplex Algorithm is a powerful method for solving linear programming problems arising in various fields.Graph theory is a formal way to represent a network. Many problems in computer system can be analyzed using models based on graphs. The concept of stochastic process deals with time varying function and plays a vital role in modeling physical phenomenon.

UNIT 1 ADVANCED MATRIX THEORY

Some important matrix factorizations – The Cholesky decomposition – QR factorization – Least squares method - Singular value decomposition - Toeplitz matrices and some applications.

UNIT 2 FOURIER SERIES AND EIGENVALUE PROBLEMS

Fourier Trigonometric series: Periodic function as power signals - Convergence of series - Even and odd function: cosine and sine series - Power signals: Exponential Fourier series - Parseval's theorem and power spectrum- Eigenvalue problems and orthogonal functions - Regular Sturm - Liouville systems -Generalized Fourier series.

UNIT 3 LINEAR PROGRAMMING

Mathematical Formulation - Graphical solution of linear programming models - Simplex method -Transportation and Assignment models.

UNIT 4 GRAPH THEORY

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

UNIT 5 STOCHASTIC PROCESS

Classification - Stationary process - Markov process - Markov chains - Transition probabilities -Limiting distributions – Poisson process – Birth and death Processes.

Lecture: 45, Tutorial: 15, Total: 60

Course Outcomes: Upon completion of this course, students will be able to:

- Apply various methods in matrix theory to solve system of linear equations. CO1
- Compute Fourier series for periodic functions, exponential Fourier series, eigenvalue problems CO2and orthogonal functions.
- Formulate and solve the LPP using graphical method, simplex method, and transportation and CO3 assignment methods.
- Apply graph theoretic algorithms in design of systems. CO4
- Classify the first and second order stationary processes and solve the problems involving Markov CO5 and Poisson processes.

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TEXT BOOKS:

- 1. Richard Bronson, "Matrix Operation", Schaum's outline series, 2nd Edition, McGraw Hill, 2011.
- 2. Larry C.Andrews and Ronald L.Phillips, "Mathematical Techniques for Engineers and Scientists ",Prentice- Hall of India Private Limited,2005.
- 3. Kanti Swarup, Gupta PK and Manmohan, "Operations Research", 14th Edition, Sultan Chand & Sons, New Delhi,2014.
- 4. NarshingDeo, "Graph Theory with applications to Engineering and computer science", Prentice Hall, Inc. Reprint 2012.
- 5. Ibe.O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 2nd Edition 2014.

- 1. David C. Lay, "Linear Algebra and its applications",4th Edition, Pearson, New Delhi,2012.
- 2. Bondy and U. S. R. Murty, "Graph theory with applications" 5 th Edition , Elsevier Science Publishing Co.,Inc,USA,2008.
- 3. Taha, H.A, "Operations Research, An introduction", 10th edition, Pearson education, New Delhi, 2013.
- 4. J. A. Veerarajan T., "Probability Statistics and Random Processes with Queueing theory and Queueing Networks", 4th Edition, Tata McGraw Hill Edition, New Delhi, 2015

22RMT01

RESEARCH METHODOLOGY AND IPR

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Pre-requisites : Nil

Preamble

Research is a scientific and systematic search for information on a particular topic or issue. It is an attempt to pursue truth through the methods of study, observation, comparison and experiment. In sum, research is the search for knowledge, using objective and systematic methods to find solution to a problem. This course also focuses on Intellectual Property Rights and explain the process of patenting

UNIT 1 RESEARCH PROBLEM FORMULATION

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations.

UNIT 2 LITERATURE REVIEW

Effective literature studies approaches, analysis, plagiarism, and research ethics

UNIT 3 TECHNICALWRITING / PRESENTATION

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT 4 INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 5 INTELLECTUAL PROPERTY RIGHTS (IPR)

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Understand the research problem and research process.
- CO2 Understand research ethics.
- CO3 Prepare a well-structured research paper and scientific presentations.
- CO4 Explore on various IPR components and process of filing.
- CO5 Understand the new developments in IPR.

TEXT BOOKS:

- 1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010
- 2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd , 2007.

- 1. Asimov, "Introduction to Design", Prentice Hall, 1962.
- 2. Mayall, "Industrial Design", McGraw Hill, 1992
- 3. Niebel, "Product Design", McGraw Hill, 1974.

22BPT11

ANATOMY AND HUMAN PHYSIOLOGY

Pre-requisites: Nil

Preamble

Human anatomy is the scientific study of the body's structures. Regional anatomy is the study of the interrelationships of all of the structures in a specific body region, such as the abdomen. In contrast, systemic anatomy is the study of the structures that make up a discrete body system—that is, a group of structures that work together to perform a unique body function. Human physiology is the scientific study of the chemistry and physics of the structures of the body and the ways in which they work together to support the functions of life.

UNIT 1 BASIC OF GENERAL PHYSIOLOGY

The Human Body: An Orientation, Cell, Cell junctions, Cell Transport, Cell Communication, Cell Division, Tissues. Acid base balance.

UNIT 2 LYMPHATIC SYSTEM AND INTEGUMENTARY SYSTEM

The Structure and Function of Skin - Microscopic Anatomy of the Skin-The Integumentary System Principles of Dermatological Evaluation & Pathophysiology of Integumentary System Lymph: Lymphatic vessels- lymphatic capillaries- lymphatic vessels- lymphatic ducts- flow of lymph - lymph nodes and its functions- Major accessory lymphatic organs- tonsils- spleen - thymus- functions of lymphatic system- disease of lymphatic system.

UNIT 3 CIRCULATROY SYSTEM

Over view of circulation - Biophysics of pressure, flow, resistance. Vascular distensibility- functions of arterial and venous systems- local and humoral control of tissue blood flow- nervous regulation of the circulation- control arterial pressure.

UNIT 4 BODY FLUIDS AND KIDNEY

Body fluid compartments- extra cellular , intracellular fluids, measurement of fluid volumes in body fluid compartments- basic principles of osmosis and osmotic pressure- urine formation- Urine Concentration and Dilution; Regulation of Extracellular Fluid Osmolarity and Sodium Concentration - acid base regulation - Diuretics- kidney diseases.

UNIT 5 ENDOCRINOLOY SYSTEM

Introduction to Endocrinology- chemical structure, synthesis of hormones- hormone secretion mechanism of action of hormones- pituitary hormone and its control by hypothalamus- thyroid metabolic hormones- synthesis, secretion, functions of thyroid hormones- adrenocortical hormones- insulin, glucagon, diabetes mellitus.

Lecture: 45, Tutorial: 0, Total: 45

Course Outcomes: Upon completion of this course, students will be able to:

- Identify and explain basic elements of human body CO1
- Explain the functions of lymphatic and integumentary system CO2
- Describe the functions of circulatory system and its relationship with biophysical parameters. CO3
- Discuss the structure, functions of kidneys, body fluids and its regulation. CO4
- CO5 Describe the physiological process of endocrinology system

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TEXTBOOKS:

1. Elaine.N. Marieb, "Essential of Human Anatomy and Physiology", Ninth Edition, Pearson Education, New Delhi, 2018.

- 1. Guyton & Hall, "Text book of Medical Physiology", 13th Edition, Saunders, 2015
- 2. Ranganathan T S, "Text book of Human Anatomy", S.Chand& Co. Ltd., New Delhi, 2012.
- 3. SaradaSubramanyam, K MadhavanKutty, Singh H D, "Textbook of Human Physiology", S. Chand and Company Ltd, New Delhi, 2012.

22BPT12

ADVANCED BIO SIGNAL PROCESSING

Pre-requisites : Signal Processing

Preamble

Advanced Bio signal processing introduces the characteristics of various bio signals and spectrum and analyse the signals in time series domain. It provides an analysis of wavelet detection, bio signal classification and recognition Algorithms. This course apply time frequency analysis and data reduction techniques to biomedical signals

UNIT 1 SIGNAL SYSTEM AND SPECTRUM

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum - power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals

UNIT 2 TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION

Time series analysis, linear prediction models, process order estimation, lattice representation, nonstationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Spectral estimation, Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability and PCG signals.

UNIT 3 ADAPTIVE FILTERING AND WAVELET DETECTION

Filtering, LMS adaptive filter, adaptive noise cancelling in ECG, improved adaptive filtering in FECG, Wavelet detection in ECG, structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets

UNIT 4 BIO-SIGNAL CLASSIFICATION AND RECOGNITION

Signal classification and recognition, Statistical signal classification, linear discriminate function, direct feature and ordering, selection Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats.

UNIT 5 TIMES FREQUENCY AND MULTIVARIATE ANALYSIS

Time frequency representation, spectrogram, Wigner distribution, Time, scale representation, scalogram, wavelet analysis, Data reduction techniques, ECG data compression, ECG characterization, Feature extraction, Wavelet packets, Multivariate component analysis, PCA, ICA.

Lecture: 45, Tutorial: 15, Total: 60

Course Outcomes: Upon completion of this course, students will be able to:

- Understand the basics of signals, systems and spectrum. CO1
- Analyse signals in time series domain & estimate the spectrum for various biosignals. CO2
- CO3 Understand the significance of wavelet detection applied in biosignal processing.
- Discuss the bio-signal classification and recognition algorithms. CO4
- Describe time frequency analysis and data reduction techniques to biomedical signals. CO5

TEXT BOOKS:

Willis J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall of India, New 1. Delhi, 2003.

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2. Rangaraj M Rangayyan, "Biomedical Signal Analysis A Case Study Approach" John Wiley, 2002

- 1. Arnon Cohen, "Biomedical Signal Processing", Vol. I and Vol. II, CRC Press Inc., Boca Raton, Florida 1999.
- 2. Reddy D C, "Biomedical Signal Processing -Principles and Techniques", The McGraw Hill Publishing Company Limited, New Delhi, 2005.
- 3. Emmanuel C. Ifeachor, Barrie W.Jervis, "Digital Signal processing, A Practical Approach", Pearson education Ltd., 2002.

22BPT13 **BIOMEDICAL SENSORS AND INSTRUMENTATION** L Т Р С

Pre-requisites : Nil

Preamble

Biomedical sensors are special electronic devices that can transduce biomedical signals into easily measurable electric signals. Biomedical sensors are the key component in various medical diagnostic instruments and equipment.

UNIT 1 TRANSDUCERS

Characteristics- Static, Dynamic, Errors in the measurements, Classification of transducers -Resistive, Capacitive, Inductive, Photoelectric, piezoelectric and mechanoelectronics.

UNIT 2 ELECTRODES & AMPLIFIERS

Half cell potential, Reference electrodes, polarization effects, Polarisable and nonpolarisable electrodes, Micro electrodes, Equivalent Circuits, Signal Conditioning circuits- Characteristics of Amplifiers, Differential Amplifiers, Filters, Bridge circuits, A/D Converters.

UNIT 3 CHEMICAL AND OPTICAL TRANSDUCERS

PH, PO2, PCO2, HCO3 electrodes, Ion sensor, Anion and Cation sensor, Liquid and solid ion exchange membrane electrode, Enzyme electrode, Principle of fiber optic cable, fiber optic sensors, Photo acoustic sensors, PPG sensors.

UNIT 4 NON ELECTRICAL PARAMETERS MEASUREMENTS

Measurements of Respiration Rate, Temperature, Pulse rate, Blood pressure Measurements- Direct, Indirect, Blood flow Measurements – Invitro, Invivo, Gas flow measurements.

UNIT 5 RECORDERS AND DISPLAY

Types of recorders, Ink jet, heated stylus, Photographic recorder, Multicolour dot scanners, CRO, storage type, long persistence, digital scope, magnetic tape recorders.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

- Analyze the Characteristics of physiological Transducer to measure a specific physiological CO1 parameter.
- Analyze the principles of bio potential sensing and electrodes to biomedical applications CO₂
- Identify and select the chemical and optical transducers based on the basic transduction CO3 principles.
- Analyze the techniques used for measurement of various non electrical physiological parameters. CO4
- CO5 Describe the different types of display and recording devices.

TEXT BOOKS:

- John G.Webster, Medical Instrumentation, Application and Design, fifth Edition, John willeyand 1. sons, 2021.
- Joseph J.Carr and John M Brown, Introduction to Biomedical Equipment Technology, 4/E, 2. Pearson education India.2001.

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- 1. Khandpur R.S, —Handbook of Biomedical Instrumentation^{II}, Tata McGraw-Hill, New Delhi, 2014.
- 2. Leslie Cromwell, —Biomedical Instrumentation and measurements, Pearson Education India, New Delhi, 2015.

22BPT14

MEDICAL IMAGING SYSTEMS

Pre-requisites : Nil

Preamble

Medical Imaging Systems explains the concept of physical interaction mechanisms for different scanning techniques like ultrasound, X-ray, CT, MRI, SPECT & PET and understand the back-projection algorithms used in CT, MR, and PET scanners.

UNIT 1 PRINCIPLES OF RADIOGRAPHIC EQUIPMENTS

X-Ray tubes, construction of image Intensifier tubes, Fluoroscopic Techniques, digital radiology, mammography, Quality assurance in X - ray equipment, Thermography

UNIT 2 COMPUTER AIDED TOMOGRAPHY

Need for sectional images, Principles of sectional scanning, Method of convolution and Back Propagation, Methods of reconstruction, Artifacts, Principle of 3D imaging, Virtual reality imaging, including image quality and quality control in CT Scanners.

UNIT 3 RADIO ISOTOPIC IMAGING

Radiation detectors, Radio isotopic imaging equipment's, scanners, Principle of semiconductor detectors, Gamma ray camera, Positron Emission Tomography, SPECT.

UNIT 4 ULTRASONIC SYSTEMS

Wave propagation and interaction in Biological tissues, Acoustic radiation, continuous and pulsed excitation, Transducers and imaging systems, Scanning methods, Principle of image generation, various advancements including doppler and image artifacts, 4D ultrasound.

UNIT 5 MAGNETIC RESONANCE IMAGING

Principles of MRI, Relaxation processes and their measurements, Pulse sequencing and MR image acquisition, Advances in MRI.

Lecture: 45, Tutorial: 0, Total: 45

Course Outcomes: Upon completion of this course, students will be able to:

- Study about X ray tube imaging techniques with its components and discussing quality CO1 assurance in X - ray tube systems.
- Formulate and construct reconstruction algorithms for computer tomography scanners. CO2
- Apply the isotopic imaging methods on Gamma ray camera, Positron Emission Tomography, CO3 SPECT.
- CO4 Analyze the benefits of ultrasonic imaging systems and explain the different scanning methods.
- CO5 Describe the performance of the magnetic resonance imaging systems.

TEXT BOOKS:

- 1. Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelpia, 1988.
- 2. Richard L. Van Metter, Jacob Beutel, Harold L. Kundel, Handbook of Medical Imaging, Volume 1. Physics and Psychophysics, SPIE, 2000

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- 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.

22BPL11CLINICAL INSTRUMENTATION AND DESIGNLTPCLABORATORY0042Pre-requisites : Medical Instrumentation Lab -1, Biochemistry Lab-1

Preamble

To enable the students to know about recording and measurements of bioelectric signals and biomolecules. To study the different preamplifiers used for amplifying the bio signals and modeling of 3D organ.

LIST OF EXPERIMENTS

- 1. Design an Operational Amplifier-various amplifier configuration.
- 2. Record and analyze the ECG signal.
- 3. Record and analyze the EMG signal.
- 4. Record and analyze the EEG signal using Lab VIEW.
- 5. Analyze the human auditory response using audiometer.
- 6. Recording of various physiological parameters using patient monitoring system and telemetry units
- 7. Estimation of biomolecules using autoanalyser.
- 8. Measurement of biomolecules optical properties by using Spectrophotometer.
- 9. Determination of Na+, K+, Li+ , Ca+ using Flame photometer.
- 10. Identification of Bacteria using Staining Techniques.
- 11. Study and evaluation of biological parameters using clinical case study.
- 12. 3D modeling of organ using open source software.

Lecture : 45, Tutorial : 0, Total : 45

- CO1 Design the amplifier for Bio signal measurements.
- CO2 Develop / Use data acquisition systems for biomedical signal/organ analysis/ modeling.
- CO3 Experiment and Determine the physiological parameters using real time patient monitoring system.
- CO4 Perform biochemical investigations and electrophoresis, immunoassays and spectroscopy techniques for analysis of biomolecules.
- CO5 Apply theoretical knowledge to interpretation of biochemical parameters in health and disease.

22BPL12 ADVANCED BIO SIGNAL PROCESSING LABORATORY L T P C

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Pre-requisites : Digital Signal Processing Laboratory

Preamble

The advanced Biosignal Processing Laboratory is to give hands on training to the students in understanding the analysis of Bio signals and develop an algorithm for preprocessing of Bio signals. Analyse the Bio signals using MATLAB platform.

LIST OF EXPERIMENTS

- 1. Design of IIR Butterworth filter using bilinear transformation method.
- 2. Design of Chebyshev IIR filter using one to one mapping method.
- 3. Design of FIR filter using Hamming window.
- 4. Analysis of ECG signal Removal of artifacts like power line interference, baseline, electrode movement, wandering etc. and study of abnormalities in ECG pattern.
- 5. Analysis of EEG Signal-Extraction of rhythms.
- 6. Analysis of EMG Signal Removal of artifacts like power line interference, baseline, electrode movement and calculate the muscle force.
- 7. Develop Pan–Tompkins method for QRS detection.
- 8. Develop cross-correlation for EEG spike and Wave detection using template matching.
- 9. Separation of Mixtures of Signals using PCA and ICA.
- 10. Heart rate variability analysis in ECG signals.
- 11. Multiresolution analysis of EEG signal using wavelet transform.

Lecture: 45, Tutorial: 0, Total: 45

- CO1 Analyze the various biosignals and to classify the abnormalities.
- CO2 Develop algorithms for denoising, power spectral density and classification of bio signals.
- CO3 Design an algorithm for QRS detection, cross correlation and wave detection.
- CO4 Design an algorithm to separate mixtures of biomedical signals.
- CO5 Analyze heart rate variability in ECG and multiresolution analysis of EEG signal.

22BPT21

Pre-requisites : Digital Image Processing

Preamble

Applied Medical Image Processing is to provide the knowledge about image fundamentals, image transforms, image enhancement techniques, restoration procedures and segmentation techniques. It provides medical image analysis, image classification, image compression methods and morphological operations over medical image and to familiarize the concepts on image registration and image visualization methods.

UNIT 1 IMAGE FUNDAMENTALS

Image perception, MTF of the visual system, Image fidelity criteria, Color Vision model, Image sampling and quantization - Two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms - DFT, DCT, DST, Hadamard Transform, Haar Transform, KLT, SVD.

UNIT 2 IMAGE ENHANCEMENT AND RESTORATION

Histogram equalization and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Contra harmonic mean filters, Homomorphic filtering, Color image enhancement. Image Restoration - Degradation model, Unconstrained and constrained restoration, Inverse filtering- Wiener filtering, Maximum entropy restoration.

UNIT 3 MEDICAL IMAGE ANALYSIS AND CLASSIFICATION

Image segmentation- Pixel based, Edge based, Region based segmentation. Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, Feature and Image classification – Statistical, Rule based, Regression analysis, Neural Network approaches.

MEDICAL IMAGE COMPRESSION AND MORPHOLOGICAL UNIT 4 PROCESSING

Fundamentals - Image compression standards- Lossy and lossless Compression - Coding: Run length -Huffman - Arithmetic - Bit plane - Predictive and Wavelet. Dilation, Erosion, Open, Close, Skeleton operations, Top-hat algorithm - Morphology based segmentation.

UNIT 5 IMAGE REGISTRATIONS AND VISUALIZATION

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Medical image Fusion, SPECT/CT, MR/CT, PET/CT. Image visualization - 2D display methods, 3D display methods, Virtual reality based interactive visualization.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

- Understand the image perception, color vision models, image sampling and quantization methods CO1 with image transforms.
- Interpret the intensity transformation techniques to enhance the images in spatial and frequency CO2 domain and restoration of images using spatial filtering techniques.

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- CO3 Develop an algorithms employed for segmentation and apply Neural Network approaches for image classification.
- CO4 Apply compression techniques and morphological operations for segmentation.
- CO5 Analyze the image registration with different modalities; render their volumes for visualization and medical image fusion.

TEXT BOOKS:

- 1. Anil. K. Jain, "Fundamentals of Digital Image Processing", Pearson education, Indian Reprint 2003.
- 2. S Esakkirajan, T Veerakumar, S Jayaraman, "Digital Image Processing", New Delhi: Tata Mc-Graw Hill India 2009.

- 1. Rafael C, Gonzalez and Richard E Woods, "Digital Image Processing", Pearson Education Asia, Fourth Edition, 2018.
- 2. Atam P.Dhawan, "Medical Image Analysis", Wiley Inter science Publication, NJ, USA 2003.
- 3. John L.Semmlow, "Biosignal and Biomedical Image Processing", MATLAB Based applications Marcel Dekker Inc., New York, 2004.
- 4. Wolfgang Birkfellner, "Applied Medical Image Processing A Basic course", CRC Press, 2011.
- 5. Reiner Salzer, "Biomedical Imaging: Principles and Applications", 1st Edition, Wiley, New Jersey, 2012.

22BPT22 **DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS**

Pre-requisites : Nil

Preamble

Biomedical Equipment's are used for measuring various physiological parameters of the human beings. Doctors were depended an instrumental value to find the conditions and treatment of the patient.

UNIT 1 BIO POTENTIAL RECORDING

Introduction to ECG, EEG, EMG, PCG, EOG, lead system and recording methods, typical waveform, frequency spectrum, abnormal waveforms. Evoked response, Electroencephalography, Electrocardiography, Electromyography.

UNIT 2 CARDIAC CARE UNITS

External and Implantable Pacemaker, Performance aspects of Implantable Pacemaker - DC defibrillator, Modes of operation and electrodes, Performance aspects of dc-defibrillator, Implantable defibrillator, defibrillator analyzers, patient monitoring system, principles of bio telemetry.

UNIT 3 DIATHERMY AND STIMULATOR

Physiological effects of HF radiation, Depth of Penetration, short wave, Ultrasonic and microwave diathermy, Surgical diathermy, Galvani, Faradic stimulators, Interferential therapy, Electrical safety-LeJRage current, Micro and macro electric shock, GFI units, Earthing Scheme, Electrical safety Analyser.

UNIT 4 ASSIST DEVICES

Heart lung machine-Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process. Hemodialyser-Indication and Principle of Hemodialysis, Membrane, Dialyasate, Different types of hemodialysers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type. Respiratory aids- Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters.

UNIT 5 RECENT TRENDS

Principles and application of thermography, Detection circuits, Principles of cryogenic Technique and application, principles of Fiber optics cables, Endoscopy, Laparoscopy, principles of Lithotripsy.

Lecture: 45, Tutorial: 0, Total: 45

Course Outcomes: Upon completion of this course, students will be able to:

- Describe the different types of, electrodes, signal conditioning circuits for acquiring and CO1 recording various biopotential.
- Describe the specific parts in Cardiac care units and working mechanisms of Cardiac Units. CO2
- CO3 Analyze the techniques used in diathermy procedure and electrical safety in medical systems.
- Explain the working principle of assist devices and monitoring systems. CO4
- Describe the Principles of Thermography, Fiber Opics cables, endoscopy, laparoscopy and CO5 lithotripsy.

TEXT BOOKS:

1. Carr -Brown, "Introduction to Biomedical Equipment Technology", 1st Edition, Pearson, New York, 2011

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2. Khandpur R.S, —Handbook of Biomedical Instrumentation^{II}, Tata McGraw-Hill, New Delhi, 2014.

- 1. John G. Webster, "Medical Instrumentation Application and Design", 4th Edition, John Wiley and sons, New Jersey, 2015
- 2. Albert M Cook and Webster J G Therapeutic medical devices, Prentice Hall, Nee York, 1982.

Pre-requisites :

22BPT11 - Advanced Anatomy and Human Physiology

Preamble

The study of mechanical properties of biological tissues and the properties of blood give us awide understanding about its structure and when it undergoes wear and when it fails. It gives knowledge about mechanical properties of hard tissues like bones to generate a mathematical model of bone structure and can be used to design medical implants using design software.

UNIT 1 FUNDAMENTALS OF BIOMECHANICS

Introduction to bio-mechanics, relation between mechanics and Medicine, Newton's laws, stress, strain, shear rate, viscosity, visco elasticity, non Newtonian viscosity, soft tissue mechanics, mechanical properties of soft biological tissues. biofluid mechanics. Steps in analyzing a biomechanical problem – Graphical methods – contact forces – resolution of forces

UNIT 2 MECHANICS OF CIRCULATION

Flow properties of blood, effect of shear rate, hematocrit, temperature and protein Content of blood, rheology of blood and micro vessels, dynamics of circulatory system, turbulence flow around prosthetic heart valves.

UNIT 3 MECHANICAL PROPERTIES OF BONES

Bone structure & composition mechanical properties of bone, cortical and cancellous bones - Electrical properties of bone, fracture mechanism and crack propagation in bones, fracture fixators, repairing of bones. Pseudo elasticity, nonlinear stress-strain relationship, viscoelasticity, structure, function and mechanical properties of skin, ligaments and tendons. Head Injury tolerance, rotational injury, spine injury – Accident reconstruction, Analysis of impact, skid analysis – Damage analysis

UNIT 4 MECHANICS OF THE JOINTS

Skeletal joints, skeletal muscles, basic considerations, basic assumption and limitations, forces and stresses in human joints, mechanics of the elbow, shoulder, spinal column, hip, knee and ankle. Structure of the Tibio femoral joint, patello femoral joint, knee joint motion – flexion, extension, rotation, Arthro-kinematics, stabilization and its contributors, positioning of the knee joints, locking/unlocking mechanism, Q- angle. Human locomotion, gait analysis and goniometry, Ergonomics, Foot Pressure measurements – Pedobarograph, Force platform, mechanics of foot. Total Hip Prosthesis: requirements, different types of components, Stress analysis & instrumentation, Knee Prosthesis.

UNIT 5 DESIGN OF MEDICAL IMPLANTS USING SOFTWARE

Importance of medical Devices, World Scenario, Design process & factors, Micro Engineering, Prototyping, Software based design of implants – MIMICS, CAD/CAM, Material Analysis, Finite Element Analysis in Orthopaedic Biomechanics – Introduction - Methodology for the finite element analysis of biomechanical systems - generate finite-element-models of the implant- bone-compound - Application of the finite-element-method for preclinical analysis of an endo- prosthetic implant - Application to the behaviour of hip prostheses - Application to the lumbar spine - Application to splints for hand therapy.

Lecture : 45, Tutorial : 0, Total : 45

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Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Describe the application of mechanics in medicine.
- CO2 Explain mechanics involved in blood flow and mechanical properties of biological tissues
- CO3 Interpret the properties of bone and analyze the impact of injuries during accident.
- CO4 Analyze the mechanics of joint involved in human locomotion
- CO5 Design orthopedic implants using 3D design software and analyze the implants using FEM.

TEXT BOOKS:

- 1. Susan J. Hall, Basics Bio Mechanics 7th Edition, McGraw-Hill Publishing Co, Newyork, 2007
- 2. Subrata Pal, "Text book of Biomechanics", 2014, 1st Edition, Viva education private limited, India.

- 1. Y. C. Fung, Biomechanics: Mechanical properties in living tissues, second Edition, Springer Verlag, New York, 1993
- 2. David Moratal, Finite Element Analysis, Sciyo Publishing, 2010.
- 3. C.R Ethier and C.A.Simmons, Biomechanics from cells to organisms, Cambridge university press,2007.

22BPT24 REHABILITATION ENGINEERING AND ASSISTIVE TECHNOLOGY

Pre-requisites :

22BPT11 - Advanced Anatomy and Human Physiology

22BPT13 - Biomedical Sensors and Instrumentation

Preamble

Develop an understanding of the various engineering principles involved in rehabilitation and assistive technology aids design. It enable the student to design assistive device to restore normal functional ability of particular organ that is defective temporarily or permanently with confidence, to help the challenged people.

UNIT 1 PRINCIPLES OF REHABILITATION

Definition, Concept of Rehabilitation: Types of Physical Impairments, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles, Engineering Concepts in Sensory & Motor rehabilitation.

UNIT 2 ORTHOTICS & PROSTHETICS IN REHABILITATION

Types of orthosis-FO,AFO,KAFO,HKAFO and Prosthesis- Partial Foot Prostheses- Foot-ankle assembly, Trans femoral Prostheses, Prosthetic Hand - Advance and automated prosthetics and orthosis, Externally powered and Controlled orthotics & prosthetics, -FES system, Restoration of Hand function, Restoration of standing and walking.

UNIT 3 MOBILITY AIDS

Different type of walking aids - Walking frames, Parallel bars, Rollators, Quadripods, Tripods & walking sticks, Crutches, Gait pattern with crutches, Electronic Travel Appliances (ETA) : Path Sounder, Laser Cane, Sonic Torch, Nottingham Obstacle Sensors, Electro cortical Prosthesis, Polarized Ultrasonic Travel aids, Wheelchairs-Categories and functions, Materials used for wheel chairs, Type of Wheel Chairs, design of wheel Chair.

UNIT 4 AUDITORY AND SPEECH ASSIST DEVICES

Types of deafness, hearing aids and their types, batteries used in hearing aids, application of DSP in hearing aids, Cochlear implants, Voice synthesizer, Speech trainer

UNIT 5 SENSORY AUGMENTATION AND SUBSTITUTIONS

Classification of Visual Impairments, Prevention and cure of visual impairments, Visual Augmentation, Tactile vision substitution, auditory substitution and augmentation, tactile auditory substitution, Assistive devices for the visual impaired, Acesscible environment and acessible information.

Lecture: 45, Tutorial: 0, Total: 45

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Course Outcomes: Upon completion of this course, students will be able to:

- Explain the appropriate rehabilitation concept for Sensory & Motor rehabilitation. CO1
- CO2 Compare the different methods of orthopedic prosthetics and orthotics for rehabilitation
- Design and develop a mobility aids and assist devices for needy people. CO3
- CO4 Interpret the auditory and speech aids for the augmentation of deaf people.
- Select proper sensory augmentation and substitution for visualy disabled person. CO5

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TEXT BOOKS:

- 1. Rory A Cooper, An introduction to Rehabilitation Engineering, Taylor & Francis, CRC Press, 2006.
- 2. Joseph D.Bronzino, "The Biomedical Engineering Handbook" Third Edition: Three volume set, CRC Press, 2006.

- 1. Dr. S.Sunder, Textbook of Rehabilitation, 3rd Edition, Jaypee Medical Publications, New Delhi, 2010.
- 2. MacLachlan M and Gallagher P, "Enabling Technologies Body Image and Body Function", Churchill Livingstone, 2004.
- 3. Mann W.C. (ed), "Smart Technology for Aging, Disability, and Independence The State of The Science", Wiley, New Jersey, 2005.

22BPL21ADVANCED MEDICAL IMAGE PROCESSINGLTPCLABORATORY0042Pre-requisites : Digital Image Processing Laboratory

Preamble

To know about medical image preprocessing. To develop the ability of designing medical image processing algorithms for segmentation, feature extraction and classification. To perform image compression techniques for medical images using MATLAB/ SCILAB/ LABVIEW platform.

LIST OF EXPERIMENTS

- 1. Preprocessing of medical images.
- 2. Apply 2-D DFT, DCT and transform for medical images (X ray/CT/MRI).
- 3. Implement DWT analysis of medical images (X ray/CT/MRI).
- 4. Develop an algorithm for medical image enhancement using histogram equalization.
- 5. Develop a non-linear filtering for medical image enhancement.
- 6. Create an algorithm to segment CT images using edge detection, line detection and boundary detection.
- 7. Apply watershed transform for medical image segmentation.
- 8. Perform the morphological operations of medical image using Dilation, Erosion and Opening, Closing.
- 9. Perform thresholding Functions using optimal threshold & Otsu's Technique for medical images.
- 10. Perform feature extraction and classification for medical images using machine learning algorithm.
- 11. Apply image compression techniques for 3D medical images.

Total: 45

- CO1 Perform Preprocessing and transform for medical images.
- CO2 Develop an algorithm for medical image enhancement and CT image Segmentation.
- CO3 Perform morphological operations of medical images.
- CO4 Apply thresholding Functions using optimal threshold & Otsu's Technique for medical images.
- CO5 Apply image compression techniques for medical images.

22BPL22 MEDICAL DEVICE DESIGN LABORATORY

L T P C 0 0 4 2

Pre-requisites : 22BPT13-Biomedical Sensors and Instrumentation

Preamble

To develop the ability of designing virtual instruments for biomedical applications. To perform the acquiring, processing, and analyzing of biosignals. To perform physiological modeling using virtual instrumentation platform.

LIST OF EXPERIMENTS

- 1. Design and simulate temperature sensor using LAB VIEW.
- 2. Monitoring of ECG signal in m-health platform using MATLAB.
- 3. Design of real time heart rate measurement system.
- 4. Cardiovascular modeling using LABVIEW
- 5. Simulation of musculoskeletal model using MATLAB
- 6. Design of Biomedical virtual instruments for processing biosignals.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Design and simulate sensors using virtual instrumentation.
- CO2 Develop medical devices in m-health platform.
- CO3 Develop virtual models for the implementation of real time applications.
- CO4 Model and simulate the physiological system using suitable simulation platform.
- CO5 Analyze the biosignals in virtual instrumentation platform.

TEXT BOOKS:

- 1. Sanjay Gupta ,VIRTUAL INSTRUMENTATION USING LABVIEW, 2nd edition,Tata McGraw Hill Publishing Education ,2010
- 2. e-resource : https://in.mathworks.com/help/simulink/index.html

- 1. https://www.researchgate.net/publication/235660672_The_research_mHealth_platform_for_ECG __monitoring
- 2. https://www.researchgate.net/publication/8907708_Modelling_of_Cardiovascular_System_Devel opment_of_a_Hybrid_Numerical-Physical_Model
- 3. https://www.researchgate.net/publication/330528637_CusToM_a_Matlab_toolbox_for_musculos keletal_simulation

22BPL31 HOSPITAL / BIOMEDICAL INDUSTRY TRAINING

Pre-requisites : Nil

Preamble

To develop the practical experience at place where biomedical equipment's are utilized.

LIST OF EXPERIMENTS

- 1.Study of Ventilator functioning.
- 2.Study of Ultrasound machine.
- 3.Study of Heart Lung Model.
- 4. Troubleshooting, maintenance and servicing of medical equipments.
- 5. Presentation on various departments and equipments in the Hospital.

Students have to undergo two weeks practical training in hospitals with the prior approval from the institution during semester holidays of that particular academic year. At the end of the training student will submit a report as per the prescribed format to the department.

Total: 45

- CO1 Implement a patient-centred approach in healthcare
- CO2 Communicate with other health professionals in a respectful and responsible manner
- CO3 Demonstrate the maintanence and service of diagnostic and therapeutic equipments.
- CO4 Propose a patient-centred inter-professional health improvement plan based upon the patient's perceived needs.
- CO5 Demonstrate patient care in hospital setting and provide access to health care professionals to get a better understanding of their work

Pre-requisites : Nil

Preamble

This course is designed to develop the ability to solve a specific problem right from its identification and literature review till the successful solution for the same. This course also trains the students in preparing project reports and in facing reviews and viva voce examination.

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 3 to 4 work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work tothe satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee shall be constituted by the Head of the Department. A project report is required at the end of the semester. 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. Progressive weightage shall be assigned to the project reviews as decided by the project review committee.

Total : 120

- CO1 Discover potential research areas in the field of Biomedical Engineering.
- CO2 Compare and contrast the several existing solutions for the problems identified.
- CO3 Formulate and propose a plan for creating a solution for the research plan identified.
- CO4 Conduct the experiments as a team and interpret the results.
- CO5 Report and present the findings of the work conducted.

Pre-requisites : Nil

Preamble

This course is designed to develop the ability to solve a specific problem right from its identification and literature review till the successful solution for the same. This course also trains the students in preparingproject reports and in facing reviews and viva voce examination.

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 3 to 4 work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work tothe satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee shall be constituted by the Head of the Department. A project report is required at the end of the semester. 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. Progressive weightage shall be assigned to the project reviews as decided by the project review committee.

Total : 180

- CO1 Discover potential research areas in the field of Biomedical Engineering.
- CO2 Compare and contrast the several existing solutions for the problems identified.
- CO3 Formulate and propose a plan for creating a solution for the research plan identified.
- CO4 Conduct the experiments as a team and interpret the results.
- CO5 Report and present the findings of the work conducted.

22BPE01

PRINCIPLES OF GENETIC ENGINEERING

Pre-requisites: Nil

Preamble

This course makes the students to understand the fundamental principles of genetics and to describe the concepts used to establish them. Genetic engineering involves the group of techniques used to cut up and join together genetic material, especially DNA from different biological species, and to introduce the resulting hybrid DNA into an organism in order to form new combinations of heritable genetic material.

UNIT 1 GENETIC INHERITANCE

Organization of DNA, Chromosomal inheritance, Eukaryotic genomes - repetitive and non-repetitive sequence, Genetic mapping - restriction cleavage, RFLP and SNPs.

UNIT 2 DNA AND PHENOTYPE

DNA structure and replication, DNA sequencing, amplification and hybridization. DNA Polymorphism, RNA transcription and processing, translation and its post translation modification. Regulation of gene expression.

UNIT 3 ENGINEERING OF GENES

Gene isolation and manipulation, mutations, repair and recombination, site directed mutagenesis, in vivo techniques of genetic manipulation, tools for analysing gene expression and genetically modified organisms

UNIT 4 HUMAN GENOME PROJECT

Human Genome Project (HGP) - an overview of the project, goals of the project, major scientific strategies & approaches used in HGP, physical mapping, gene ontology, gene annotation, techniques in HGP - microsatellite markers, STS, EST, DNA sequencing and DNA microarray, scientific & medical benefits of this project.

UNIT 5 IMPACT OF GENETIC VARIATION

Gene involvement in the generation of genetic variations, Integral view of natural strategies to generate genetic variations: Local sequence change, DNA rearrangement, DNA acquisition. Population Genetics, Quantitative Genetics, Evolution Genetics.

Lecture : 45, Tutorial : 0, Total: 45

Course Outcomes: Upon completion of this course, students will be able to:

- Interpret different forms of inheritance patterns and identify them in genetic data CO1
- CO2 Analysis the evolutionary levels of genetic sequence
- CO3 Interpret the outcomes of statistical analysis associated with the genome research project
- Evaluate the molecular genetic information. CO4
- CO₅ Conduct a research project involving the analysis of real molecular genetic data

TEXT BOOKS:

1. Anthony J.F. Griffiths, Susan R. Wessler, Sean B. Carroll, John Doebley, Introduction to Genetics Analysis, - W.H Freeman & company, New York 11th Edition - 2015

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2. Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten —Molecular Biotechnology, Principles and application of Recombinant DNA 4th Edition ASM Press, 2010

- 1. Karp, Gerald Cell and Molecular Biology. Concepts and Experiments, 7th Edition, John Wiley Sons, 2013.
- 2. Watson. J. etal, Molecular Biology of the Gene —, 7th Edition, Pearson Publication, 2014

Pre-requisites : Engineering Physics

Preamble

To develop an understanding of physics involved in various imaging modalities and the effect of radiation on human body

UNIT 1 PRINCIPLES OF NUCLEAR PHYSICS

Structure of matter - atom - nucleus -atomic mass and energy units, mechanical properties of atom, emission of light and its frequencies. Electromagnetic spectra, Laws of equilibrium - Theory of decayelectron capture - internal conversion - nuclear isomerism- Natural radioactivity, Decay series, type of radiation and their applications, accelerator principles; reactor and cyclotron produced isotopes - fission products- artificially produced isotopes and its application - Radionuclides used in Medicine and technology.

UNIT 2 PHYSICS OF INFRARED, MICROWAVE AND RADIO FREQUENCY

Production and properties - interaction mechanism of RF and microwaves with biological systems: Thermal and non-thermal effects on whole body, lens and cardiovascular systems - tissue characterization and Hyperthermia and other applications. Biomagnetism – Effects, applications- Infrared detectors, thermographic equipment's, quantitative medical thermography, pyroelectric video camera, applications of thermography.

UNIT 3 LASER PHYSICS AND MEDIPHOTONICS

Basics of Laser Light, Characteristics of laser radiation, Laser speckle, biological effects, laser safety management Synthesis of vitamin D in early and late cutaneous effects, Phototherapy, photo hemotherapy, exposure level, hazards and maximum permissible exposures. Optical characteristics of biomolecules from the point of spectroscopy, principles of UV, Visible absorption, IR and FTIR absorption, Raman and Fluorescence spectroscopy.

UNIT 4 DIAGNOSTIC ULTRASOUND

Ultrasonic waves, generation and detection of ultrasound, Beam characteristics, attenuation of ultrasound, interaction ultrasound with tissues - Safety levels of Ultrasound, real time scanners image clarity, Resolution - axial and lateral resolution. Artifacts, Pulse echo imaging, Obstetrics abdominal investigations - Echo cardiograph (UCG). The Doppler Effect- Doppler Shift, continuous wave Doppler system, Pulsed wave Doppler systems - duplex scanning, display devices for ultrasonic imaging.

UNIT 5 RADIOBIOLOGICAL EFFECT OF RADIATION

Target theory, single hit and multi target theory, cellular effects of radiation, DNA damage, chromosomal damage, Somatic effect: Radio sensitivity protocol of different tissues in human, LD 50/30 effect, Genetic effect: Threshold of linear dose effect, relationship factors affecting frequency of radiation induced mutation, biological effect of microwave, RF wave and UV radiation.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Explain the principles of Electromagnetic spectrum and effects of radioactivity in nuclear medicine.
- CO2 Interpret the properties and applications of RF and microwaves in biological systems.

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- CO3 Explain the Characteristics and exposure of laser.
- CO4 Discuss the ultrasound principle and Doppler effect in scanning and clinical applications.
- CO5 Describe the effect of radiation in genetics.

TEXT BOOKS:

- 1. Branski.S and Cherski.P, Biological effects of microwave, Hutchinson&ROSS Inc.Stondsburg 1980.
- 2. Peter W. Milonni, Joseph H. Eberly, LASER PHYSICS, Wiley and son's publication, 2010.

- 1. Jerrold T. Bushberg, J. Anthony Seibert, Edwin M. Leidholdt, John M. Boone, The essential Physics for Medical Imaging, 2011, Wolters Kluwer Health.
- 2. Simon R. Cherry, James A. Sorenson, and Michael E. Phelps, Physics in Nuclear Medicine, Elsevier, 4th Edition, 2012.
- 3. Karl F. Renk , Basics of Laser Physics For Students of Science and Engineering, 2nd edition: © Springer International Publishing AG 2017.
- 4. <u>https://www.researchgate.net/publication/345132061_THE_DIFFERENCE_IN_NATURE_OF_</u> <u>RADIO-WAVES_MICROWAVES_AND_INFRARED_WAVES</u>
- 5. <u>https://www.researchgate.net/publication/315381123_FUNDAMENTALS_IN_NUCLEAR_PHY</u> <u>SICS</u>

С 22BPE03 **ADVANCED BIOMATERIALS AND ITS APPLICATIONS** L Т Р

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Pre-requisites : Biomaterials and Artificial Organs - 1

Preamble

To introduce concepts of materials, surface and tissue placement in biomaterial functions for understanding diverse elements controlling biological responses to materials and provide contemporary biomaterial principles.

UNIT 1 INTRODUCTION

Definition of biomaterials, mechanical properties, surface chemistry of materials, surface modification, Tissue Reaction, Wound Kinetics, and Bio Compatibility.

UNIT 2 MATERIALS FOR MEDICINE

Metals, Ceramics, Polymers and Biomimetic Materials, Composites. Material preparation, chemical composition, Properties, uses in medicine and biosciences and failure mechanisms.

UNIT 3 STERLIZATION OF BIOMATERIALS

Sterilization techniques: - process and mechanism of action of steam sterilization, radiation sterilization, and electron beam sterilization, ethylene oxide, and chlorine dioxide and plasma gas sterilization.

UNIT 4 TESTING OF MATERIALS

Testing with Tissue Culture - in vitro and in vivo assessment of biocompatibility, testing with Soft Tissues and testing at non Thrombogenic surface - blood compatibility and thromobogenicity. ISO 10993- standard for assessment of biocompatibility.

UNIT 5 HARD AND SOFT TISSUE REPLACEMENT

Orthopedic Implants, Neuromuscular Implants, Dental Implants, Transcutaneous Implants, Intraocular lenses Cardiac Implants, Blood Interfacing Implants, Percutaneous and Skin Implants.

Lecture: 45, Tutorial: 0, Total: 45

Course Outcomes: Upon completion of this course, students will be able to:

- Determine and analyze how the properties of the biomaterials affect interactions with cells and CO1 tissues.
- Identify the relationship between structure and function polymers, biomimetic, composites, CO2 ceramics and metals as biomaterials.
- Categorize the various sterilization techniques used for obtaining sterility of materials. CO3
- Interpret the role of material testing by using knowledge of engineering concerns and CO4 hemodynamic assessment of organs.
- Propose the choice of biomaterials for implantation in the blood, soft tissue and hard tissue CO5 replacement.

TEXT BOOKS:

- Park, J.B and Lakes, R.S., "Biomaterials An Introduction", Springer Publications, 3rd edition, USA, 1. 2007.
- Buddy D.Ratner, Allan S .Hoffman, Frederick J. Schoen, Jack E. Lemons, Biomaterial Science; 2. An Introduction to Materials in Medicine, 3rd Edition, Elsevier Academic Press, 2013.

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- 1. Joseph D. Bronzino and Donald R. Peterson, The Biomedical Engineering Handbook, fourth edition, CRC Press Taylor & Francis, 2015.
- 2. Jytte Brender. Handbook of Evaluation Methods for Health Informatics, Elsevier Academic Press: Burlington, MA, 2006.
- 3. Antonios G. Mikos and Johnna S. Temenoff, Biomaterials: The Intersection of Biology and Materials Science, Pearson International edition, 2008.
- 4. Andrew F.VonRacum, Handbook Of Biomaterials Evaluation: Scientific, Technical And Clinical Testing Of Implant Materials, Second Edition, CRC Press, 1998.

BIO STATISTICS

Pre-requisites : Applied Mathematics

Preamble

Bio Statistics helps to perform statistical & regression analysis and also to compare the various parameters used in statistical significance.

UNIT 1 FUNDAMENTAL STATISTICAL TOOLS IN ENGINEERING RESEARCH 9

The Engineering Method and Statistical Thinking - Collecting Engineering Data - Basic Principles - Retrospective Study - Observational Study - Designed Experiments -Observing Processes Over Time - Mechanistic and Empirical Models. Data Description and Representation: Collection of data-Classification and Tabulation of data - Stem-and-Leaf Diagrams - Frequency Distributions and Histograms - Box Plots - Time Sequence Plots - Probability Plots .

UNIT 2 DESCRIPTIVE STATISTICS

Measures of central Tendency-Measures of Dispersion-Skewness and Kurtosis. Correlation and Regression: Types of Correlation – Scatter Diagram – Karl Pearsons Coefficient of Correlation and Spearmen's Rank Correlations- Method of Least Squares - Regression (The two regression lines).

UNIT 3 SAMPLING

Different types of sampling - Sampling Distributions - Sampling Distribution of Mean. Point Estimation of Parameters: General Concepts of Point Estimation - Unbiased Estimators - Variance of a Point Estimator - Standard Error- Methods of Point Estimation (Method of Moments - Method of Maximum Likelihood). Statistical Intervals for a Single Sample: Confidence Interval on the Mean of a Normal Distribution with Variance Known - Confidence Interval on the Mean of a Normal Distribution with Variance Unknown - Confidence Interval on the Variance and Standard Deviation of a Normal Distribution - A Large- Sample Confidence Interval for a Population Proportion.

UNIT 4 TESTS OF HYPOTHESES FOR A SINGLE SAMPLE

Tests of Statistical Hypotheses - General Procedure for Hypothesis Testing –Tests on the Mean of a Normal Distribution with Variance Known - Tests on the Mean of a Normal Distribution with Variance Unknown - Tests on the Variance and Standard Deviation of a Normal Distribution. Statistical Inference for Two Samples: Inference for a Difference in Means of Two Normal Distributions with Variances Known - Inference for a Difference in Means of Two Normal Distributions with Variances Unknown - Inference on the Variances of Two Normal Distributions with Variances.

UNIT 5 THE ANALYSIS OF VARIANCES

Concept- Assumptions-One way classification and two-way classifications. Designing Engineering Experiment: Concept of Randomization, Replication and local control-Completely Randomized Design. Randomized Block Design- Latin square Design.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

CO1 Understand the role of Statistics and basic principles of data description and representation in solving engineering problems.

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- CO2 Interpret the requirements for the existence of a relationship between two variables.
- CO3 Analyze the acquaint with the concept of different sampling methods.
- CO4 Carry out tests of hypotheses on the samples to arrive at conclusions on the population.
- CO5 Understand the difference between fixed and random factors.

TEXT BOOKS:

- 1. Mohammed A.Shayib. Applied Statistics, First Edition. eBook, Bookboon.com 2013.
- 2. Peter R.Nelson, Marie Coffin, Copeland Kanen, A.F. Introductory Statistics for Engineering Experimentation, Elsevier Science and Technology Books, New York, 2003.

- 1. Chap T. Le, Lynn E. Eberly, Introductory Biostatistics, 2nd Edition, John Wiley & Sons, Inc.,2016.
- 2. Richard A. Johnson and C.B.Gupta, Probability and Statistics for Engineers, (7thEdn.), Pearson Education, Indian Impression 2006.
- 3. Sheldon M. Ross, Introduction to Probability and Statistics, (3rdEdn), Elsevier Science and Technology Books, New York, 2004.

22BPE05

ULTRASOUND PRINCIPLES AND ITS MEDICAL APPLICATIONS

Pre-requisites: Nil

Preamble

This course teaches the principles of ultrasonics and its interaction with tissue, Ultrasound scanning techniques, real time scanners and medical applications of these principles.

UNIT 1 PRINCIPLES OF ULTRASONICS

Introduction, Piezo Electric Devices, The Fields of _simple ', CW excited sources, The Pulsed Acoustic field, Effects of human body on Beam Propagation, Beam formation by transducer arrays, Magnitudes of Acoustic Field variables, Displacement detectors Thermal mechanisms, Cavitation, Radiation Pressure.

UNIT 2 TISSUE-ULTRASOUND INTERACTION

Introduction, Absorption in biological tissues, Tissue-Ultrasound interaction cross sections, Theory of mechanisms for the absorption of ultrasonic longitudinal waves, Measurement of attenuation and Absorption Coefficients in tissues, Acoustic properties reflecting different levels of tissue organization, Molecular aspects of soft tissue mechanics, Structural contribution to bulk and shear acoustic properties of tissues. Relevance to tissue characterization, Ultrasound quantitation and tissue characterization

UNIT 3 SCANNING TECHNIQUES

Ultrasound transducers, Construction of ultrasonic probe, Measurement of ultrasonic energy, pulse echo imaging, Pulse echo equation, Transducer motion, Transmit steering and focusing, Beam forming and Dynamic focusing, Transmitter, Receiver, Positional information, Scan converter-Analog, Digital. Image display, Image position, Transducer output, signal processing, adjustment of controls. Scanning Techniques- Acoustic windows, Scanning motion, Transducer Selection, Scan Indexing. Basic Image Interpretation-Contour, Internal Echo pattern, Attenuation, Classification, Artifacts

UNIT 4 REAL TIME ULTRASONIC SCANNERS

Different modes of display-A mode, B mode, M mode, B-scan System, The Principles of Ultrasound Motion Detection, Techniques for Measuring Target Velocity, Phase Fluctuation (Doppler Methods), Envelope Fluctuation Methods, Phase Tracking Methods, Envelope Tracking Techniques, Ultrasound Imaging Systems, Considerations Specific To Color Flow Imaging, Angle Independent Velocity Motion Imaging, Tissue Elasticity & Echo Strain Imaging, Performance Criteria, Use of Contrast Media, Real Time Echo, 2-D and 3-D Scanners, Color Doppler.

UNIT 5 ULTRASONIC APPLICATIONS

Ultrasonic diagnosis in Abdomen, Breast, Thyroid, Heart, Chest, Eye, Kidney, Skull, Pregnant and Non Pregnant uterus, 3-Dimensional Ultrasonic Imaging of The Fetus, Advantages And Limitations of 3-Dimensional Ultrasound.

Lecture : 45, Tutorial : 0, Total: 45

Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Describe the principles of Ultrasonics and its interaction with living systems.
- CO2 Quantifying interactions between ultrasound and biological tissues.
- CO3 Specify suitable ultrasonic scanning method for imaging different organs
- CO4 Develop real time Scanners to view inside the body
- CO5 Apply the 3-Dimensional Ultrasound scanner to diagnosis diseases.

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TEXT BOOKS:

- 1. Khandpur R.S Hand Book of Biomedical Instrumentation Tata Mc Graw Hill publication, New Delhi 2nd edition 2003.
- 2. C.R.Hill, Jeff C.Bamber, Gail Haa, Physical Principles of medical Ultrasonics; John Wiley & Sons Ltd; 2nd Edition, 2004.

- 1. James Revell, Majid Mirmehdi and Donal McNally, -Computer Vision Elastography: Speckle Adaptive Motion Estimation for Elastography using Ultrasound Sequences, IEEE Transactions on Medical Imaging, Vol.24, No.6, June 2005.
- 2. Hassan Rivaz, Emad Boctor, Pezhman Foroughi, Richard Zellars, Gabor and Gregory Hager,-Ultrasound Elastography: A Dynamic Programming Approachl, IEEE Transactions on Medical Imaging, 2008.

22BPE06 **ADVANCED BRAIN COMPUTER INTERFACE**

L Т Р С 3 0 0 3

Pre-requisites : 22BPT21 Advanced Bio Signal Processing

Preamble

It introduces the basic concepts of Brain Computer Interface with various signal acquisition methods and signal processing methods used in BCI.

UNIT 1 INTRODUCTION TO BCI

Fundamentals of BCI - Structure of BCI system - Classification of BCI: Invasive, Non-invasive and Partially invasive BCI- Brain signal acquisition, Signal Preprocessing, Artifacts removal.

UNIT 2 ELECTROPHYSIOLOGICAL SOURCES

Sensorimotor activity –Neuronal activity in motor cortex and related areas- Electric and Magnetic fields produced by the brain- Signals reflecting Brain Metabolic Activity- Mu rhythm, Movement Related Potentials - Slow Cortical Potentials - P300 Event Related Potential - Visual Evoked Potential -Activity of Neural Cells - Multiple Neuro-mechanisms.

UNIT 3 FEATURE EXTRACTION METHODS

Time/Space Methods - Fourier Transform, Wavelets, AR, MA, ARMA models, Bandpass Filtering, Template Matching, Kalman Filter, PCA, Laplacian Filter – Linear and Non-Linear Features.

UNIT 4 FEATURE TRANSLATION METHODS

Linear Discriminant Analysis -Nearest Neighbours, Support Vector Machines - Regression -Learning Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

UNIT 5 APPLICATIONS OF BRAIN-COMPUTER INTERFACES

Introduction-BCIs for Assistive Technology – BCIs for Recreation - BCIs for Cognitive Diagnostics and Augmented Cognition - Rehabilitation and Prosthetics, Functional Near-Infrared Sensing (fNIR) and Environmental Control Applications - Near Infrared Sensing Technology - The OTIS System - Basic BCI Application - Environmental Control with fNIR, Brain-Computer Interfacing and Games.

Lecture : 45, Tutorial : 0, Total:45

Course Outcomes: Upon completion of this course, students will be able to:

- Interpret the Invasive and Non Invasive BCIs and Acquire the brain signal in the format required CO1 for the specific application.
- Preprocess the signal for signal enhancement to measure the Sensorimotor activity and Brain CO2 Metabolic Activity.
- CO3 Extract the dominant and required features using transform and filtering techniques.
- Characterizes two or more classes of events using LDA, SVM, HMM and Neural networks CO4
- Illustrate the application of Brain Computer Interface. CO5

TEXT BOOKS:

- Jonathan Wolpaw and Elizabeth Winter Wolpaw, Brain-Computer Interfaces: Principles and 1. Practice, Published to Oxford Scholarship 2012, Print ISBN-13: 9780195388855.
- Desney S. Tan Anton Nijholt, Brain-Computer Interfaces Applying our Minds to Human-2. Computer Interaction, Springer-Verlag London Limited 2010, ISSN 1571-5035, ISBN 978-1-84996-271-1.

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- 1. Andrew Webb, —Statistical Pattern Recognition^{II}, Wiley International, Second Edition, 2002.
- 2. Carlo Tomasi, —Estimating Gaussian Mixture Densities with EM A Tutoriall, Duke University, 2000.

22BPE07

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Pre-requisites: Nil

Preamble

This course introduces the fundamentals of Tissue Engineering, fundamentals of cell mechanisms, Physical & biological interactions and application of Tissue Engineering

UNIT 1 FUNDAMENTALS OF TISSUE ENGINEERING

Introduction to Tissue Engineering - Objectives of Tissue Engineering - Basic definitions - Structure and organization of Tissues - Development of Tissue - Tissue exchange and diffusion of simple metabolites - Tissue Equivalent - Wound Healing Process - Biocompatibility and toxicity assessment.

UNIT 2 FUNDAMENTALS OF CELL MECHANISMS

Cell adhesion, Cell migration and Cell aggregation – Cell growth and Cell cycle. Cellular Interactions: Cell - Cell and Cell - Matrix. Control of Cell migration in Tissue Engineering -Cell delivery and Recirculation - Cell Culture in vitro - 3D culture in Tissue Engineering - In vitro Organogenesis - Cell transplantation.

UNIT 3 BIOMATERIALS IN TISSUE ENGINEERING

Definition - Biological vsNonbiological materials - Extra Cellular Matrix - Collagen, Chitin & Degradable and Nondegradable materials - Polymer, Ceramics and Metals - Cell interaction with different materials -- Scaffolds - Control releaser agents in Tissue Engineering - Cell interaction with suspension and gels – Tissue response to implants.

UNIT 4 STEM CELLS IN TISSUE ENGINEERING

Introduction of Stem cells - Hemopoetic Stem cells - Embryonic Stem cells - Adult stem cells - Cancer Stem cells - Cord Blood cells - Induced Pluripotent Stem cells - Stem cell identification - Surface markers & FACS analysis - Differentiation, Dedifferentiation and Immortalization - Application of stem cells in tissue Engineering.

UNIT 5 TISSUE ENGINEERING APPLICATIONS

Synthetic components - Artificial organs - Joints and dental prostheses - Connective Tissue Engineering - Cardiovascular Tissue Engineering - Neural Tissue Engineering - Cell and Drug Delivery systems.

Lecture : 45, Tutorial : 0, Total: 45

Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Describe the importance of tissue engineering in the field of biomedical engineering
- Identify the mechanisms involved in interaction of different materials with cells and tissues CO2
- Prepare and characterize biomaterials for tissue engineering applications. CO3
- CO4 Develop new stem cells-based tissue engineering approaches.
- Create new models in drug delivery systems using synthetic and natural scaffolds CO5

TEXT BOOKS:

1. Gary E Wnek, Gary L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York, 2nd edition, 2008.

2. R.Lanza, J.Gearhart et.al, (Eds), Essential of Stem cell Biology, Elsevier Academic Press, 2nd edition 2009.

- 1. Robert P. Lanza, Robert Langer and Joseph Vacanti., Principles of Tissue Engineering, 2nd Edition, Academic press, Elsevier 2013.
- 2. SujataV.Bhatt, Biomaterials (2nd Edition), Narosa Publishing House, 2005.

22BPE08 WEARABLE DEVICES AND TECHNOLOGIES

Pre-requisites : 22BPT21 Advanced Bio Signal Processing

Preamble

It introduces the basic principles of Wearable Monitoring Systems along with Smart Sensors to monitor vital parameters and acquire the knowledge to design a Wearable Computer & Wireless Body Area Networks.

UNIT 1 INTRODUCTION TO WEARABLES

Wearable Systems- Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Types of Wearable Systems, Components of Wearable Systems, Physiological Parameters Commonly Monitored in Wearable Applications, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles, Sport Application, Smart Fabrics: Intelligent Textiles.

UNIT 2 WEARABLE DEVICES FOR HEALTHCARE AND VITAL PARAMETERS 9

Vital Parameters Monitored and their Significances, Bio-potential Signal Recordings (ECG, EEG, EMG), Dry Electrodes Design and Fabrication methods, Cuff-less Blood Pressure Measurement, PPG, Galvanic Skin Response (GSR), Body Temperature Measurements, Activity Monitoring for Energy Expenditure, Respiratory parameters, Wearable sensors for Body Temperature: Intermittent and Continuous temperature monitoring, Detection principles – thermistor, infrared radiation, thermopile.

UNIT 3 COMMUNICATION TECHNOLOGIES

Principles of different sensors, Micro-Motors and Communication Channels - Accelerometers, Optical sensor, GPS- Various Input Methods, Power Requirements, Wearable Systems Packaging, Batteries and Charging, Wireless Communication Technologies and Protocols, Receiver Systems.

UNIT 4 WIRELESS BODY AREA NETWORKS

Wireless Body Area Networks – Introduction, Personal Area Networks (PAN), Application in Vital Physiological Parameter monitoring, Design of Sensor & Sink Nodes, Architecture, Communication & Routing Protocols, Security, Power and Energy Harvesting, Mobile Applications Based Devices.

UNIT 5 DATA PROCESSING AND VALIDATION

Classification Algorithms, Data Mining and Data Fusion, Signal Processing Algorithms in Wearable Applications, Issues of Wearable Physiological Monitoring Systems, Statistical Validation of Parameters, Certifications of Medical Devices and Patenting.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Explain the basics of wearable system and Physiological Parameters Commonly Monitored in Wearable Applications.
- CO2 Use Smart Sensors to monitor vital parameters of ECG, EEG, EMG signals.
- CO3 Design Wireless Body Area Networks using short and long range communication technologies.
- CO4 Identify the use of various wearable BAN network for monitoring.

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CO5 Apply Classification Algorithms to identify the category of new observations and validate it.

TEXT BOOKS:

- 1. Edward Sazonov, Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elseiver, 2014.
- 2. Annalisa Bonfiglo, Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011.
- 3. Wearable and Autonomous Biomedical Devices and Systems for Smart Environment", by Aimé Lay-Ekuakille and Subhas Chandra Mukhopadhyay, Springer 2010.

- 1. A. Gieras, The proliferation of patient-worn wireless telemetry technologies within the U.S. Healthcare environment. Proc. 4th IEEE Conf. on Information Technology Applications in Biomedicine, 2003: 295–298.
- 2. Lymberis, Smart wearables for remote health monitoring, from prevention to rehabilitation: current R&D, future challenges. Proc. 4th IEEE Conf. on Information Technology Applications in Biomedicine, Birmingham, UK, 2003: 272–275.

22BPE09

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Pre-requisites: Nil

Preamble

BioMEMS is a subset of micro electromechanical systems (MEMS) and microtechnology. In order to study various biological phenomenon in a more controlled manner BioMEMS has been used as in vitro platform for diagnostics, therapy, transporting drugs or monitoring of processes in the body. Bio-MEMS is typically more focused on mechanical parts and micro fabrication technologies made suitable for biological applications.

UNIT 1 MEMS MATERIALS 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 2 MECHANICAL AND THERMAL SENSORS AND ACTUATORS

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

UNIT 3 ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS 9

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

UNIT 4 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, di electrophoresis, microfluid dispenser, microneedle, micropumps-continuous flow system, micromixers

UNIT 5 APPLICATION OF BIO MEMS

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

Lecture: 45, Tutorial: 0, Total: 45

Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Understand the operation of different types of sensors and actuators at microscale level.
- CO2 Understand the design issues at microscale level.
- CO3 Choose the material for any application.
- CO4 Apply the concepts to the design of different types of micro systems.
- CO5 Apply the knowledge of CAD tools for MEMS design.

TEXTBOOKS:

- 1. TaiRanHsu, "MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, NewDelhi, 2002. (Unit I, II, III &IV).
- 2. Wanjun Wang, Stephen A.Soper, "BioMEMs: Technologies and Applications", CRCPress, New York, 2007. (Unit V).

- 1. MarcJ. Madou "Fundamentals of Micro fabrication: the Science of Miniaturization", CRCPress,2002
- 2. Nadim Maluf, Kirt Williams. "An introduction to Micro electromechanical Systems Engineering", Second Edition, Artech House Inc, MA,2004.
- 3. ChangLiu," Foundations of MEMS", Pearson Education International, NewJersey, USA, 2006
- 4. Nitaigour Premchand Mahalik, "MEMS", Tata McGraw Hill Publishing Company, NewDelhi, 2007

22BPE10

PATTERN RECOGNITION TECHNIQUES AND ITS L T APPLICATIONS 3 0

Pre-requisites : Nil

Preamble

Pattern recognition aims to classify objects of interest into one of a number of categories or classes. Pattern Recognition is the science of making inferences from the perceptual data using the tools from statistics, probability, computational geometry, machine learning, signal processing and algorithm design.

UNIT 1 PATTERN CLASSIFIER

Overview of Pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation – Problems with Bayes approach–Pattern classification by distance functions – Minimum distance pattern classifier.

UNIT 2 CLUSTERING

Clustering for unsupervised learning and classification – Clustering criteria - Clustering algorithms Clustering concept –Hierarchial clustering, Partitional clustering- k-means algorithm – Validity of Clusters.

UNIT 3 FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION 9

KL Transforms – Feature selection through functional approximation – Binary selection -Elements of formal grammars - Syntactic description - Stochastic grammars - Structural representation.

UNIT 4 HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINE

State Machines – Hidden Markov Models – HMM Parameters-Training – Classification – Support vector Machine – Learning the Linear Discriminant Function - SVM for Classification - Feature Selection, Combination of Classifiers.

UNIT 5 RECENT ADVANCES AND APPLICATIONS

Fuzzy logic – Fuzzy Pattern Classifiers – Case Study Using Fuzzy Pattern Classifiers CAD system in breast cancer detection, ECG signal classification, Fingerprint recognition, cell cytology classification, Handwritten Digit Recognition.

Lecture : 45, Tutorial : 0, Total : 45

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Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Explain and compare a variety of pattern classification and pattern classifier combination techniques.
- CO2 Conduct hierarchical cluster analysis and k-means clustering to identify clusters in multivariate data.
- CO3 Illustrate the feature extraction through functional approximation and structural representation of patterns.
- CO4 Describe the state machines, hidden Markov models and support vector machine.
- CO5 Apply the fuzzy logic using fuzzy pattern classifier for the various real time applications.

TEXT BOOKS:

1. Andrew Webb, -Stastical Pattern Recognition, Arnold publishers, London, 2002.

2. C.M.Bishop, -Pattern Recognition and Machine Learning, Springer, 2006.

- 1. M. Narasimha Murthy and V. Susheela Devi, -Pattern Recognition, Springer 2011.
- 2. S.Theodoridis and K.Koutroumbas, -Pattern Recognition, 4th Ed., Academic Press, 2008.

Co-requisites : 22BPL31 Hospital / Biomedical Industry Training Preamble:

Hospital planning, organization and management introduce to formation of organization and principles of hospital management process also in details about staff requirement and its process, basic marketing management process then digitalized record maintenance.

HOSPITAL PLANNING, ORGANIZATION AND MANAGEMENT L

UNIT 1 FORMATIONS OF ORGANISATION

Sole proprietorship, Partnership, Company - public and private sector enterprises. Organizational structure: Governance - Duties and responsibilities of the governing board - governing board and conflict of interest. Management structure: Committee organization-the chief executive officer-Duties, Responsibilities and functions of CEO-the CEO and his management team-organizational chart.

UNIT 2 PRINCIPLE OF HOSPITAL MANAGEMENT

Importance of management and Hospital, Management control systems. Professional management of the hospital. Financial management: factions-design-organization-space requirements-other requirementsproblem situations-internal control. Human resource management: factions-design-organization-space requirements-other requirements.

UNIT 3 STAFFING

22BPE11

Staffing pattern in hospitals, requirement and Selection, Recruiting process, Orientation, Training and development, Career development. Human Resources Development: Employee Development-Hospital Personnel, Physician Recruitment, and Professional Employer Organizations-Cultural Transformations. Strategic Planning: Capacity Workforce Management-Accounting Management. Leadership: Operations Management-Decision Making and Communications Management.

UNIT 4 HOSPITAL AND MANAGEMENT

Basic concepts marketing, Principles of social marketing, Social marketing in health sector, Consumer behavior and research health, Advertising in Health Sector, Relevance of e-marketing of Health care services. Healthcare marketing strategies-the role of marketing in healthcare system-the impact of marketing strategies-effective marketing ideas in healthcare.

UNIT 5 COMMUNICATION SYSTEMS IN HOSPITAL

System Development life cycle. Communication Systems: Reasons to use telephone in hospital, Reasons to use computers in hospital, main categories of information systems in hospitals. Integrated Service Digital Network (ISDN)-Telemedicine, teleconsulting and net telephony- Nurse call system- Public address system and piped music- television and closed circuit television.

Lecture: 45, Tutorial: 0, Total: 45

Course Outcomes: Upon completion of this course, students will be able to:

- Students will have a general idea about the fundamentals of hospital organization. CO1
- Students will have an idea of the overall Managerial Functions which can be applied in any CO₂ organizational set up.
- Students will have a better understanding of human behavior in organization and selection of CO3 staffing.
- CO4 Students will have a general idea about the fundamentals of marketing management.
- Students will be equipped with the practical exposure to basics of computing. CO5

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TEXT BOOKS:

- 1. G. D. Kunders Hospitals: Facilities Planning and Management, Tata McGrawHill Education, New Delhi, 2004
- 2. Goyal R.C., Human Resource Management in Hospital, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
- 3. Hospitals Health Care Organizations Management Strategies, Operational Techniques, Tools, Templates, and Case Studies (David Edward Marcinko, Hope Rachel Hetico) (z-lib.org) https://1lib.in/book/2373976/a8d6ca.

- 1. Nauhria R.N. and Rajnish Prakash, Management & systems, New Delhi Wheeler publishing, 1995.
- 2: Syed Amin Tabish, Hospitals & Nursing Homes: Planning, Organisations & Management, Jaypee
- ^{2.} Brothers Medical Publishers (P) Limited, 2003.

MACHINE LEARNING TECHNIQUES

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Pre-requisites : Neural Network

Preamble

Machine learning introduces the concept of various machine learning algorithms, linear model, distance based model and graphical model along with various deep learning techniques for real world application and acquire the knowledge of fine tuning the performance of the network.

UNIT 1 INTRODUCTION

Probability theory - model selection - Decision theory - Information theory - Entropy and mutual information. Types of machine learning - Supervised learning - Unsupervised learning - Reinforcement learning - Basic concepts of machine learning - parametric and non-parametric models - linear and logistic regression.

UNIT 2 LINEAR MODELS

Least squares method - Multivariate linear regression - regularized regression - perceptron - Support Vector Machines - hard SVM, soft SVM - going beyond linearity - generalization and overfitting -Regularization.

UNIT 3 DISTANCE BASED MODELS

Nearest neighbour models - K means - clustering around medoids - silhouettes - hierarchical clustering -Decision tree - univariate tree - multivariate trees - Dimensionality reduction - principle component analysis - linear discriminant analysis.

UNIT 4 GRAPHICAL MODEL

Naive Bayes classifier - hidden Markov model - Linear regression - Reinforcement learning - Elements of reinforcement learning - model based learning - temporal difference learning - generalization.

UNIT 5 DEEP LEARNING TECHNIQUES

Deep generative model - deep directed networks - deep Boltzmann machines - deep belief networks multilayer perceptrons - auto encoders - stacked denoising auto encoders - application of deep networks.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

- Analyze mathematical foundation for machine learning and familiarize with the basic concepts of CO1 machine learning.
- Design a support vector machine algorithm and a linear regression model and fine tune the CO2 algorithm using regularization technique.
- Analyze various distance based models such as nearest neighbor models, hierarchical clustering CO3 and decision tree algorithm and perform dimensionality reduction techniques.
- Acquire the knowledge of classifier and comprehend the reinforcement learning model and CO4 perform generalization technique.
- CO5 Analyze various deep learning model such as deep directed network and auto encoder network.

TEXT BOOKS:

1. Peter Flach, 'Machine Learning: The art and science of algorithms that make sense of data', Cambridge University Press, 2012.

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2. Christopher M. Bishop, 'Pattern Recognition and Machine Learning', Springer, 2013.

- 1. Tom M Mitchell Machine Learning, First Edition, McGraw Hill Education, 2017.
- 2. Shai Ben-David and Shai Shalev-Shwartz, 'Understanding Machine Learning: From Theory to Algorithms', Cambridge University Press, 2014.

22BPE13

PHYSIOLOGICAL MODELING SYSTEMS

Pre-requisites :

Preamble

Physiological Modeling Systems analyze the any physiological systems through the models and Characterize the physiological signal with Feedback systems & simulation techniques.

UNIT 1 INTRODUCTION

System Concept, System Properties, Piece-Wise Linear Approximation, Electrical Analog for Compliance, Thermal Storage, Mechanical Systems, Step response of a Resistance/Compliant Systems, Pulse Response of First Order System.

UNIT 2 TRANSFER FUNCTION

System as an Operator use of Transfer Function, Bio Engineering of a Coupled System, Example of Transformed Signals and Circuits for the Transfer Function with Impedance Concept, Prediction of Performance.

UNIT 3 PERIODIC SIGNALS

Sinusoidal Functions, Sinusoidal Analysis of Instrumentation System, Evaluation of Transfer Function s from Frequency Response, Relationship between Phase Lag and Time Delay Transient Response of an Undamped Second Order system, General Description of Natural Frequency Damping, Physical Significance of Under Damped Responses.

UNIT 4 FEEDBACK SYSTEMS

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 5 SIMULATION OF BIOLOGICAL SYSTEMS

Simulation of Skeletal muscle servomechanism, thermo Regulation, cardiovascular control System, Respiration controls, Occulo Motor System, Endocrine control system and Modeling of receptors.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to: CO1 Understand and appreciate the value and application of Physiological models and Vital organs.

- CO2 Develop mathematical background to understand the order of the
- system using transfer function.
- CO3 Determine the frequency and transient response for the closed loop transfer function with the given periodic input signals.
- CO4 Acquire knowledge about Physiological Feedback systems and simulating different Physiological Feedback systems.
- CO5 Develop differential equations to describe the dynamic models, simulate and visualize, dynamic responses of physiological models using software.

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TEXT BOOKS:

- 1. Douglas S. Rigg, Control Theory and Physiological Feedback Mechanism, The William and Wilkins Co, Baltimore, 1970.
- 2. Michael C.K. Khoo, "Physiological Control System" Analysis, Simulation and Estimation"-Prentice Hall of India, New Delhi, 2001.

- 1. Manfreo Clynes and John H. Milsum, Biomedical Engineering System, McGraw Hill and Co, New York, 1970.
- 2. Richard Skalak and Shu Chien, Hand Book of Biomedical Engineering, McGraw Hill and Co, New York, 1987.
- 3. William B. Blesser, A System Approach to Biomedicine, McGraw Hill Book Co, New York, 1969.

HOSPITAL MANAGEMENT SYSTEM

Co-requisites : 22BPL31 Hospital / Biomedical Industry Training Preamble:

Hospital architecture is introduced to healthcare system and verity of hospital planning process. The basic designing of different services availed in hospital, required standards and norms for hospital and facilities for supportive services.

UNIT 1 INTRODUCTION TO HEALTH CARE SYSTEM

International and National level policy framework for healthcare facilities – Types of healthcare facilities based on public and private ownership, bed size and type of health care services based on outpatient, inpatient and diagnostic care - Organizational, function and structure of the hospital.

UNIT 2 HOSPITAL PLANNING

22BPE14

Principles of planning, regionalization, hospital planning team, planning process, size of the hospital, site selection, hospital architect, architect report, equipping a hospital, interiors & graphics, construction & commissioning, planning for preventing injuries, electrical safety.

UNIT 3 PLANNING & DESIGNING OF DIFFERENT SERVICES IN HOSPITALS

Planning and designing of administrative services, medical and ancillary services, nursing services, supportive services, public areas and staff services, hospital services.

UNIT 4 STANDARDS AND NORMS FOR HOSPITALS

Design and construction standards for the hospitals namely BIS –India and JCAHO, AIA and NHS– general guidelines and standard for out-patient area, in-patient area and diagnostic area in the hospitals. Voluntary & Mandatory standards, General standards, Mechanical standards, Electrical Standards, Standard for centralized medical gas system, Standards for biomedical waste.

UNIT 5 FACILITIES FOR SUPPORTIVE SERVICES

Transport, Information system, Communication, Food services, Mortuary, Heating Ventilation and Air Conditioning, Medical gases, House Keeping, Laundry.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Students will have a general idea about the fundamentals of healthcare system.
- CO2 Students will have an idea of the overall hospital planning which can be processed in any organizational set up.
- CO3 Students will have a better understanding of hospital services and designing.
- CO4 Students will have a general idea about the standards and norms for the hospital.
- CO5 Students will be equipped with the exposure to facilities and their supportive services.

TEXT BOOKS:

- 1. G. D. Kunders Hospitals: Facilities Planning and Management, Tata McGrawHill Education, New Delhi, 2004
- 2. Purnima Sharma, Sangeet Sharma, Nerendra Malhotra, Jaideep Malhotra. Step by Step Hospital Designing and Planning^{||}, 2nd Edition, Jaypee Brothers-Medical publishers, New Delhi, 2010.

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- 1. S.K.Gupta, S.kant, R.Chandrashekhar, S.Satpathy, Modern trends in planning and designing of hospitals: Principles and practice', Jaypee Brothers-Medical publishers, New Delhi, 2007.
- Sa Tabish, Hospital and Nursing Homes planning, Organisation and Management, Jaypee 2. Brothers-Medical publishers, New Delhi, 2003.

22BPE15 HEALTH POLICY AND EQUIPMENT MANAGEMENT L T P (

Pre-requisites : Nil

Preamble

To expose the students for planning, operation and equipment maintenance management skills of hospital and how to protect equipment from electromagnetic interferences, in every department that is involved in clinical care.

UNIT 1 HEALTH SYSTEM

Health organization of the country, the state and cities, health financial system, teaching cum research hospitals, General Hospital, PHC reference system, Ambulatory Care.

UNIT 2 NATIONAL HEALTH POLICY

Need for evaluating a health policy, need for providing primary health care, Health education, health insurance, health legislation, inter sectoral cooperation.

UNIT 3 EQUIPMENT MAINTENANCE MANAGEMENT

Organizing the maintenance operation, biomedical equipment procurement procedure, proper selection, compatibility, testing and installation, purchase and contract procedure, trained medical staff, on proper use of equipment and operating instructions. Maintenance job planning, preventive maintenance, maintenance budgeting, contract maintenance.

UNIT 4 MEDICAL DEVICE RISK, REGULATION AND GOVERNANCE

Medical Device Risks - Risk Categories, Clinical Governance, Risks during Equipment Operation. Logistic and Reliability: Maintenance equipment and Tools, failure analysis, spare parts and maintenance materials. Reliability fundamentals.

UNIT 5 PERFORMANCE MANAGEMENT & EMI IN HOSPITAL EQUIPMENTS

Maintenance effectiveness and efficiency, Performance benchmarking. Principles of EMI, computation of EMI, Method of suppressing and isolating the unit from interference.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Explain the general system of hospital in states and cities.
- CO2 Discuss the need of health policies and education in all sectors.
- CO3 Describe about equipment installation, service & calibration needs.
- CO4 Interpret the risks of medical device and failure analysis of materials.
- CO5 Explain the efficiency of maintenance and role of EMI in hospital equipment's.

TEXT BOOKS:

- 1. Antony Kelly, `Maintenance Planning & control' Butterworth, London 1984.
- 2. Binseng Wang, Medical Equipment Maintenance: Management and Oversight, Morgan & Claypool Publishers, 2012.

REFERENCES:

- 1. Medical Equipment Management, Keith Willson, Keith Ison, Slavik Tabakov CRC Press, 2013.
- 2. R.C.Goyal `Human Resource Management in Hospitals' Prentice Hall of India, New Delhi, 2000.

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- 3. https://www.researchgate.net/publication/326773745_National_Health_Policy_of_India
- 4. <u>https://www.nhp.gov.in/nhpfiles/national_health_policy_2017.pdf</u>

22BPE16 **COMPUTER BASED MEDICAL INSTRUMENTATION** L Т Р С

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Pre-requisites : 22BPT13-Biomedical Sensors and Instrumentation

Preamble

To provide the knowledge of PC hardware and its related peripheral interfacing to the students. To give a complete overview of 80x86 processors and their related mother boards. It also showcases the basics of computerized data acquisition and simulation based environments.

UNIT 1 COMPUTER HARDWARE AND INTERFACING

PC Motherboard components-System resources -System and peripheral control chips-Expansion buses and I/O ports-Peripherals-BIOS services. Expansion buses-ISA, EISA, PCI bus. Parallel port-standard parallel port-Enhanced parallel port-Enhanced capabilities port.

UNIT 2 PROCESSORS AND MEMORY MANAGEMENT

80X86 Processors - Architectures and Memory management -Pentium processors-Pentium Organization Overview of 80X86 based Mother boards.

UNIT 3 COMPUTERIZED MEDICAL INSTRUMENTS

Computerized ECG, EEG and EMG-Patient Monitoring systems-Arrhythmia and Ambulatory Monitoring Instruments-Biomedical Telemetry

UNIT 4 COMPUTERIZED DATA ACQUISITION AND INTERFACES

Plug-in-data acquisition and Control Boards. Data acquisition using GPIB: Overview of GPIB-GPIB commands-GPIB programming-Expanding GPIB -IEEE -488.2-SCPI-HS488 protocol. Data acquisition using Serial Interfaces -serial communication-serial interface standards-PC serial port-microcontroller serial interfaces-USB-IEEE1394.

UNIT 5 VIRTUAL INSTRUMENTATION

Basics of Virtual Instrumentation- Instrument control - GPIB - VISA - instrument drivers-serial port communication. Data Acquisition: Transducers and Signal conditioning, DAQ hardware- Analog inputs – Analog outputs- Digital I/O- DAQ assistant and configurations.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

- Classify the mother board components and identify the different interfacing peripherals for CO1 communication.
- CO2 Describe various processors and their memory management techniques.
- Identify and discuss the working of computer based medical instruments. CO3
- Discuss about the serial Interfaces and standards required for the computerized data acquisition CO4 systems.
- CO5 Develop and simulate virtual instruments using software simulation tools.

TEXT BOOKS:

- N.Mathivanan, PC Based Instrumentation: Concepts and Practice, Prentice Hall of India, New 1. Delhi 2013.
- 2. B.Govindarajalu, IBM PC and Clones: Hardware, Trouble shooting and Maintenance, Tata McGraw Hill Publishing Company, New Delhi, 2005

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- 3. R.D.Lele, "Computers in medicine progress in medical informatics", Tata McGraw Hill,2005
- 4. Jovitha Jerome "Virtual Instrumentation using labview" Prentice Hall of India, NewDelhi, 2011.

- 1. Stephen J Bigelow, Trouble shooting, Maintaining and Repairing of PCs, Tata McGraw Hill Publishing Company, New Delhi, Fifth edition 2005.
- 2. Mohan Bansal, "Medical informatics", Tata McGraw Hill Publishing Ltd, 2003
- 3. Sanjay Gupta, Virtual Instrumentation using labview, 2nd edition, Tata McGraw Hill Education, 2010.

22BPE17

Pre-requisites : Nil

Preamble

Nano science and Technology introduces the basic of Nano science and its technology. The advancement of the field and its applications in biomedical Engineering.

UNIT 1 INTRODUCTION OF NANOPARTICLES

Overview of nanoscience, nano biomaterials-Types, structure and interaction. smart nanomaterialsproperties, synthesis, characterization, Classifications of nanomaterials - Zero dimensional, onedimensional and two dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and super lattice clusters of metals,

UNIT 2 PROTEIN AS NANOSTRUCTURES

Protein based nanostructures building blocks and templates - Proteins as transducers and Amplifiers nanobioelectronic devices and polymer nanocontainers – microbial production of inorganic nanoparticles - magnetosomes. Scanning tunneling microscopy-Principle- Instrumentation- importance of STM for nanostructures

UNIT 3 DNA AS NANOSTRUCTURES

DNA based nanostructures - Topographic and Electrostatic properties of DNA - Hybrid conjugates of gold nanoparticles - DNA oligomers - use of DNA molecules in nanomechanics.

UNIT 4 NANOPARTICLES IN DIAGNOSIS

Introduction to nanoparticles in diagnostics- nuclear imaging, optical imaging, PET, Micro PET, cardio vascular disease studies, imaging and therapy of thrombosis, emerging Ethical issues and toxicology of nanomaterials.

UNIT 5 NANOTHERAPEUTICS

Nanoparticles as carriers in drug delivery- design, manufacture and physiochemical properties, transport across biological barriers. Artificial organs with biomaterials-Artificial heart, prosthetic cardiac valves, limb prosthesis, externally powered limb prosthesis, Dental implants

Lecture: 45, Tutorial: 0, Total: 45

Course Outcomes: Upon completion of this course, students will be able to:

- Analyze the Properties of nanoparticles and its medical applications. CO1
- Understand the design of Protein that are used as nano structures. CO2
- Design of DNS and its properties as nanostructures are understood. CO3
- CO4 Analyze the diagnosis of diseases using nanoparticles.
- Understand the therapeutical usage of nano particles. CO5

TEXT BOOKS:

- 1 G. Cao, Nanostructures & Nanomaterials: Synthesis, Properties & Applications, Imperial College Press. 2004.
- S.L.Flegler, J.W.Heckman and K.L.Klomparens, "Scanning and Transmission Electron 2 Microscopy. A Introduction", W.H.Freeman & Co, 1993

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- 3 L. Hench and J. Jones, "Biomaterials, Artificial Organs and Tissue Engineering", Woodhead Publishing in Materials, 2002.
- 4 Vinod Labhasetwar, Diandra L. Leslie-Pelecky, Biomedical Applications of Nanotechnology, John Wiley & Sons, 2007.
- 5 Joon Park, D.B. Joseph and Boca Ration, "Biomaterials: Principles and Applications", CRC, Press, 2003.

DEEP LEARNING TECHNIQUES

Pre-requisites : Machine Learning

Preamble

Deep learning introduces the concept of convolution neural network and recurrent neural network along with the fundamental concepts of machine learning algorithms and wavelets transforms and acquire the knowledge of fine tuning the performance of the network through regularization techniques.

UNIT 1 OVERVIEW OF MACHINE LEARNING

Learning Algorithms - Capacity, Overfitting and Underfitting - Hyper parameters and Validation Sets -Estimators, Bias and Variance – Bayesian Estimates – Maximum Likelihood Estimation – Supervised Learning Algorithms - Unsupervised Learning Algorithms - Stochastic Gradient Descent - Building a Machine Learning Algorithm – Challenges Motivating Deep Learning.

UNIT 2 DEEP FEED FORWARD NETWORKS

Multiresolution formulation of wavelet systems- signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filter banks-Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet Packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.

UNIT 3 REGULARIZATION FOR DEEP LEARNING

Parameter Norm Penalties - Dataset Augmentation - Noise Robustness - Semi-Supervised Learning -Multi-Task Learning - Early Stopping - Parameter Tying and Parameter Sharing - Bagging and Other Ensemble Methods - Dropout - Adversarial Training.

UNIT 4 CONVOLUTIONAL NETWORKS

The Convolution Operation - Motivation - Pooling - Variants of the Basic Convolution Function -Structured Outputs Efficient Convolution Algorithms. Applications: Computer Vision.

UNIT 5 SEQUENCE MODELING

Recurrent and Recursive Nets: Recurrent Neural Networks - Bidirectional RNNs - Encoder-Decoder Sequence to-Sequence Architectures - Deep Recurrent Networks - Recursive Neural Networks - The Long Short-Term Memory and other Gated RNNs. Applications: Natural Language Processing.

Lecture: 45, Tutorial: 0, Total: 45

Course Outcomes: Upon completion of this course, students will be able to:

- Design a machine learning algorithm for real world problem and fine tune the algorithm by CO1 tuning hyper parameters to overcome under and overfitting.
- Familiarize with various wavelet systems and filter banks for analysis of the deep feed forward CO2 network.
- CO3 Analyze various regularization techniques to improve the performance of the deep learning architectures.
- CO4 Design a deep convolution neural network for computer vision problem along with various components such as convolution, activation and pooling.
- Design a recurrent neural network for the application of natural language processing and analyze CO5 various RNN architectures.

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TEXT BOOKS:

- 1. Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press, 2017..
- 2. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.

- 1. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.
- 2. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012.

Pre-requisites : Engineering Physics I

Preamble

Biophotonics deals with interactions between light and biological matter. It is an exciting frontier which involves a fusion of photonics and biology. It offers great hope for the early detection of diseases and for new modalities of light guided and light activated therapies.

BIOMEDICAL OPTICS

UNIT 1 OPTICAL PROPERTIES OF THE TISSUES

Refraction, Scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, opto-thermal interaction, fluorescence.

UNIT 2 INSTRUMENTATION IN PHOTONICS

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

UNIT 3 SURGICAL APPLICATIONS OF LASERS

Laser in tissue welding, lasers in dermatology, lasers in ophthalmology, otolaryngology, Urology, Lasers in Neurosurgery, Laser Treatment of Breast Tumors, Therapeutic Applications of Lasers in Gastroenterology.

UNIT 4 DIAGNOSTIC APPLICATIONS

Optical coherence tomography, Elastography, Fluorescence Imaging, Raman Imaging, SEM, TEM, FLIM, X-Ray Diagnostic Techniques, Speckle Correlometry, Near-Field Imaging in Biological and Biomedical Applications.

UNIT 5 THERAPEUTIC APLLICATIONS

Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological and nononcological applications of PDT - Biostimulation effect – applications.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Demonstrate knowledge of the fundamentals of optical properties of tissues.
- CO2 Analyze the components of instrumentation in medical photonics and configurations.
- CO3 Describe surgical applications of lasers.
- CO4 Describe photonics and its diagnostic applications.
- CO5 Investigate emerging techniques in medical optics.

TEXT BOOKS:

- 1. Tuan Vo Dirh, Biomedical Photonics-Handbook, CRC Press, Bocaraton, 2014.
- 2. Mark E. Brezinski, —Optical Coherence Tomography: Principles and Applications, Academic Press, 2006.

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- 1. H. Niemz, Laser-Tissue Interaction Fundamentals and Applications, Springer, 2007.
- 2. R. Splinter and B.A. Hooper, —An Introduction to Bio-Medical Optics^{II}, Taylor and Francis, 2007.
- 3. Paras N. Prasad, —Introduction to Bio photonics, A. John Wiley and sons, Inc.Publications, 2003.

28-05-2022

22BPE20

Pre-requisites : Nil

Preamble

This course focus on giving introduction to some new fields in soft computing with its principal components of fuzzy logic and GA which helps students to differentiate traditional and genetic algorithm. This course gives insightful study about problems incurred in various domains and the comprehensive soft computing techniques provides solution to these problems benefiting the students for the pursuit of allied research.

ADVANCED NEURAL COMPUTING

UNIT 1 BASIC CONCEPTS OF NEURAL COMPUTING

Biological Neurons and their Artificial models, Models of artificial Neural Networks, Learning and Adaptation, Neural Network Learning Rules, Single Layer Perceptron Classifiers.

UNIT 2 BPN AND BAM

Back Propagation Network, Generalised Delta Rule, BPN Application, Associative Memory definition, BAM, Hopfield Memory, Simulated Annealing - Information Theory and statistical mechanics -Boltzmann Machine.

UNIT 3 OTHER NEURAL NETWORKS

Counter Propagation Network -CPN building blocks - CPN Data Processing - Feature Mapping, Self Organising Feature Maps - SOM data processing - applications of SOM, Adaptive Resonance Theory (ART) Network Descriptions.

UNIT 4 GENETIC ALGORITHMS & IMPLEMENTATION TECHNIQUES

Fundamentals of genetic algorithm-Mathematical foundations-Genetic modeling- Survival of the fittest crossover- Inversion and Deletion-mutation-reproduction Generational cycle- rank method-rank space method- Other derivative free optimization simulated annealing- Random search- Downhill simplex search- Applications.

UNIT 5 ADVANCES AND APPLICATIONS

Support Vector Machines, R B F Network, Neocognitron Evolving neural networks using GA, Applications of ANN in biomedical signal analysis and Medical image analysis.

Lecture: 45, Tutorial: 0, Total: 45

Course Outcomes: Upon completion of this course, students will be able to:

- Explain basic concepts of neural networks and learning rules used for neural computing. CO1
- Illustrate the back propagation neural networks and back propagation associative memory in sogt CO2 computing.
- Describe the neural networks such counter propagation network, self organising feature maps and CO3 adaptive resonance theory
- Discuss the genetic algorithms and implementation techniques for various applications. CO4
- Apply the support vector machines and artificial neural networks in biomedical signal analysis CO5 and medical image analysis.

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TEXT BOOKS:

- 1. David Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison Wesley USA, 1997.
- 2. Jang J.S.R., Sun C.T and Mizutani E, -Neuro Fuzzy and Soft Computing: A Computational Approach to Learning Machine Intelligence, Prentice Hall, 1997.

- 1. James A Freeman and David M.Skapra, Neural Networks, Addison Wesley, India 1999.
- 2. Melanie Mitchell, An Introduction to Genetic Algorithms: Prentice Hall of India, New Delhi 1998.

22BPO01 BIOMEDICAL WASTE MANAGEMENT IN HOSPITALS L T

Pre-requisites : Nil

Preamble

Nano science and Technology introduces the basic of Nano science and its technology. The advancement of the field and its applications in biomedical Engineering

UNIT 1 HEALTHCARE HAZARD CONTROL

Introduction -general and hazardous health care waste and diseases, Healthcare Hazard Contro-: Introduction, Hazard Management, Hazard Analysis, Hazard Correction, Personal Protective Equipment, Hazard Control Committees, Accident Causation Theories, Accident Reporting, Accident Investigations, Analysis, Prevention, Workers- Compensation, Orientation, Education, and Training.

UNIT 2 BIOMEDICAL WASTE MANAGEMENT

Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, waste minimization, waste segregation and labeling, waste handling, collection, storage and transportation, treatment and disposal.

UNIT 3 DISPOSAL OF WASTE

Need for disposal of biomedical waste, Disposal methods - Incinerator - Hazardous waste-, radioactive waste, liquid waste destruction - landfill.- Healthcare Hazardous Materials, Medical Gas Systems, Respiratory Protection.

UNIT 4 CONTROLS APPLIED TO WASTE MANAGEMENT

Environmental pollution- its causes, consequences, mitigation and remedies. Emission control, Instrumentation and monitoring, Crematories. Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, Medication Safety. Patient-Centered Healthcare, Quality Improvement Tools and Strategies, Healthcare-Associated Infections.

UNIT 5 ENVIRONMENTAL SAFETY, RISKS & PUBLIC ISSUES

Risk management in hospitals - Environment issues in hospitals - Risk analysis Legislation, policies and law regarding environment on Health care waste management. Biomedical waste management and handling rules, 1998 and its amendment.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Understanding of Hazards in hospitals and measure to control the hazards.
- CO2 Understand the Source of hospital waste
- CO3 Analysis of various methods & means to dispose waste
- CO4 Design of system to control the waste management
- CO5 Understand and design safety environment and the public issues.

TEXT BOOKS:

- 1. C.R.Brunner, Medical Waste Disposable Handbook, Incentrated, Consultant in Corporated, Virginia, 2000.
- 2. Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor and Francis (2014).

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- 1. Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012).
- 2. Healthcare Hazardous Materials, Medical Gas Systems, Respiratory Protection.

22BPO02

INTRODUCTION TO CLINICAL TRAILS

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Pre-requisites: Nil

Preamble

Clinical research is necessary to establish the safety and effectiveness of specific health and medical products and practices. Randomized controlled trials form the foundation for "evidence-based medicine", It.describes the clinical research process as it relates to health and medical products, and identifying and explaining each of the activities that are common to most trials and the parties who are ordinarily responsible for carrying them

UNIT 1 BASIC CONCEPTS IN CLINICAL RESEARCH

Basics of epidemiology, Definition, scope, and uses of epidemiology Measures of disease and death frequency, Mortality and morbidity, epidemiological study designs, Observational studies, descriptive studies, experimental studies, Ecological studies, cross sectional studies, cohort studies, case control studies, incidence, prevalence, odds ratio, relative risk, ethical and regulatory aspects of clinical research, ethical issues in preclinical (animal studies and clinical studies)

UNIT 2 CLINICAL TRIAL DESIGNS

Basics of Clinical Trials: need clinical trials, Brief History of Clinical Trials, Glossary of Common Terms in clinical Trials: Clinical Research, Healthy Volunteer, Inclusion/Exclusion Criteria, Informed Consent, Patient Volunteer, Phases of Clinical Trials, Placebo, Protocol, Principal Investigator, Randomization, Single- or Double-Blind, Studies, Types of Clinical Trials. - Diagnostic trials, Natural history studies, Prevention trials, Quality of life trials, Screening trials, Treatment trials. Clinical Trial Protocol and its components. Type of analyses: ITT, and PP.

UNIT 3 RANDOMIZED CONTROLLED TRAIL

Randomized controlled trial - Reasons for randomization, Features of RCT – design and conduct of RCT - Random allocation, Allocation concealment, Blinding, Conduct, Outcome ascertainment, Sample size, Power of a study. Reporting of RCT- Randomization and Masking, Overview of Clinical Study Design

UNIT 4 MANAGEMENT OF CLINICAL DATABASE

Clinical Trials Metrics Collection, Clinical Data Management, Data Processing – Database -Definition of Data Management and its benefits -Types of data: data collection methods, raw, physical collection, models, images etc. –Data entry - File naming – Data assurance: quality control and assurance of data, medical coding, dictionary management and maintenance of quality documents

UNIT 5 DATA SAFETY

Missing data, submitting data, Metadata: Metadata standards, submitting Data, File formats, preserve: Backup of data, Migration: Transformation of data, discovering data, Integrate: Merging of multiple data sets, Data Citation, Data retrieval, Archiving, Double data entry and checking, Quality control and Data Cleaning

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Narrate the imporatance of spreading and measurement of disease.
- CO2 Discuss the terms, phases of clinical trails and study of different clinical trails.
- CO3 Describe the features and different methods of randomized control trail.
- CO4 Categorize the different types of data and its managemnt in clinical trails
- CO5 Summarize the types of file format for the safety maintenance of data

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TEXTBOOKS:

- 1. P. Michael Dubinsky, Karen A. Henry "The fundamentals of clinical research: A universal guide for implementing good clinical practice" wiley, 2022
- Lawrence M. Friedman, Curt D. Furberg, David L. DeMets, David M. Reboussin, Christopher B. Granger "Fundamentals of clinical trails" Springer Cham, Edition:5, 2015

- 1. David machin, simon day, and sylvan green "Text book of clincal trails" Wiley, 2014
- 2. Tom brody "Clincal trails:study design, end points and biomarkers, drug safety and FDA and ICH guidelines" Second edition, Elseiver Inc.2016
- 3. "Hand book for good clinical research practice (GCP) : Guidance for implementation", WHO Library Cataloguing-in-Publication Data 2005

22BPO03 QUALITY ASSURANCE AND SAFETY IN HOSPITALS L

Pre-requisites :-Nil

Preamble

The purpose of this course is to help students to develop knowledge and insight into the procedures used in quality control and assurance activities as well as safety measures to be followed in hospitals.

UNIT 1 STANDARDIZATION OF QUALITY MEASURES IN HEALTHCARE ORGANIZATION

Define Quality- Need for Standarization & Quality Management, QM in Health care organization-Quality assurance methods ,QA in (Medical Imaging & Nuclear medicine) Diagnostic services – Classification of equipments

UNIT 2 HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES

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

UNIT 3 BIOMEDICAL WASTE MANAGEMENT

Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling, collection, storage and transportation, treatment and disposal.

UNIT 4 SAFETY FACILITY

Introduction: Facility Guidelines Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Scaffolding, Fall Protection, Tool Safety, Machine Guarding, Compressed Air Safety, Electrical Safety, Control of Hazardous Energy, Permit Confined Spaces, OSHA Hearing Conservation Standard, Heating, Ventilating, and Air-Conditioning Systems, Assessing IAQ, Landscape and Grounds Maintenance, Fleet and Vehicle Safety.

UNIT 5 REGULATORY REQUIREMENTS AND QUALITY IN HOSPITAL

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABA, JCI, NABL.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Standardize the quality of healthcare equipments as per the standards of regulatory bodies.
- CO2 Create Hospital as centralized one by implementing Hospital Information system and various supportive systems.
- CO3 Manage and dispose the biomedical waste in Hospital environment to ensure the cleanliness of the hospital.
- CO4 Implement various Safety measures to create safer environment in the Hospital.
- CO5 Adopt the Policies and procedures of various bodies to maintain the standards as per the need of the concern bodies.

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TEXT BOOKS:

- 1. B.M.Sakharkar, Principles of Hospital administration and Planning, JAYPEE Brothers, Medical Publishers (P) Ltd
- 2. Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012).

- 1. Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor and Francis (2014).
- 2. K.Shridhara Bhat, Quality Management, Himalaya Publishing House Cesar A. Cacere & Albert Zana, The Practice of Clinical Engg. Academic press, New York, 1977.
- Sharon Myers "Patient Safety & Hospital Accreditation A Model for Ensuring Success" Springer Publishers 2012 7. Joseph F Dyro "Clinical Engineering Handbook" Elsevier Publishers, 2004

22BPO04

TELEMEDICINE TECHNOLOGY

Pre-requisites : Nil

Preamble

Telemedicine Technology course introduces the basic concepts of telemedicine and systems, knowledge of telehealth technology and mobile telemedicine. This course also discuss the applications of telemedicine for Telehealthcare.

UNIT 1 FUNDAMENTALS OF TELEMEDICINE

Telemedicine - Biomedical Telemetry - History of Telemedicine - Benefits of Telemedicine - Types of Telemedicine services. Delivery mechanisms in Telemedicine – Telemedicine standards and guidelines.

UNIT 2 TELEMEDICINE SYSTEMS

Tele medicine process - Essential parameters - Components of telemedicine systems - Delivery modes in Telemedicine: Store and Forward Telemedicine - Real time Telemedicine - Hybrid Systems - Remote Monitoring.

UNIT 3 TELE MEDICAL TECHNOLOGY

Information sources in a Telemedicine system – Data transmission – Transmission of still images: Image compression, Data compression, DICOM. Transmission of video: Video compression technology -Transmission of Audio: Voice compression - Speech codecs. Telecommunication technologies: POTS, DDS, ISDN, Internet, DSL, ADSL, Satellite communication.

UNIT 4 MOBILE TELEMEDICINE

mHealth - Key technologies for mHealth - Wireless connectivity in mHealthv - Ubiquitous Healthcare -Wireless Body Area Network (WBAN) – Wireless Personal Area Network (WPAN) – Wireless Sensor Network (WSN) – mHealth in Intensive care monitoring – Mobile Telemedicine.

UNIT 5 APPLICATIONS OF TELEMEDICINE

Teleradioology: Types of Imaging modalities - Components of a Teleradiology system -Teleultrasonography. Telepathology – Telecardiology – Teleophthalmology - Telesurgery: Telementoring – Robot assisted surgery. Telerehabilitation.

Lecture: 45, Tutorial: 0, Total: 45

Course Outcomes: Upon completion of this course, students will be able to:

- Understand the fundamentals of telemedicine. CO1
- Acquire knowledge on various telemedical technologies. CO2
- Familiarise the protocols and techniques of transmission of data. CO3
- Discuss the key technologies for mobile telemedicine. CO4
- Discuss the applications of Telemedicine in Telehealthcare. CO5

TEXT BOOKS:

- 1. R.S. Khandpur, "Telemedicine: Technology and Applications (mHealth, TeleHealth and eHealth)", PHI Learning Private Limited, 2017.
- Bernard Fong, A.C.M. Fong, C.K. Li, "Telemedicine Technologies: Information Technologies in 2. Medicine and Tele health", Wiley, 2011.

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- 1. Wootton, R., Craig, J., Patterson, V., "Introduction to Telemedicine. Royal Society of Medicine" Press Ltd, Taylor & Francis 2006.
- 2. Ferrer, Roca, O., Sosa, Iudicissa, M. (editors), "Handbook of Telemedicine", IOS Press (Studies in Health Technology and Informatics, Volume 54). (ISBN 90-5199-413-3), 2002.
- 3. Magnuson, J.A., Fu, Jr., Paul C. (Eds.), "Public Health Informatics and Information systems", ISBN 978-1-4471-4237-9, Springer, 2014.

22AC01 ENGLISH FOR RESEARCH PAPER WRITING L Т Р

Pre-requisites : Nil

UNIT 1 INTRODUCTION TO RESEARCH PAPER WRITING

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT 2 PRESENTATION SKILLS

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT 3 TITLE WRITING SKILLS

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT 4 RESULT WRITING SKILLS

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT 5 VERIFICATION SKILLS

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

Lecture: 45, Tutorial: 0, Total: 45

Course Outcomes: Upon completion of this course, students will be able to:

- Understand that how to improve your writing skills and level of readability CO1
- CO2 Learn about what to write in each section
- CO3 Understand the skills needed when writing a Title
- Understand the skills needed when writing the Conclusion CO4
- CO5 Ensure the good quality of paper at very first-time submission

TEXT BOOKS:

- Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht 1. Heidelberg London, 2011.
- Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006. 2.
- Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006 3.
- Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998. 4.

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22AC02

Pre-requisites : Nil

Preamble

This course is useful to provide students an exposure to disasters- their significance and types and knowledge on relationship between vulnerability- disasters- disaster prevention and risk reduction.

DISASTER MANAGEMENT

UNIT 1 INTRODUCTION

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT 2 REPERCUSSIONS OF DISASTERS AND HAZARDS

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT 3 DISASTER PRONE AREAS IN INDIA

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

UNIT 4 DISASTER PREPAREDNESS AND MANAGEMENT

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT 5 RISK ASSESSMENT

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Lecture : 45, Tutorial : 0, Total : 45

Course Outcomes: Upon completion of this course, students will be able to:

- Identify and explain the types of disasters- causes and their impact on environment and CO1 society.
- CO2 Identify and explain the vulnerability and various types of hazards.
- Draw the hazard and vulnerability profile of India- Scenarios in the Indian context- Disaster CO3 damage assessment and management.
- CO4 Apply the remote sensing and GIS techniques for predicting the natural disasters.
- Discuss how to work on recovery & risk assessment due to disasters. CO5

TEXT BOOKS:

28-05-2022

- 1. Singhal J.P, —Disaster Management, Laxmi Publications- 2010.
- Tushar Bhattacharya, -Disaster Science and Management, McGraw Hill India Education Pvt. 2. Ltd.- 2012.

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- 1. Gupta Anil, K.Sreeja, S. Nair, —Environmental Knowledge for Disaster Risk Management-NIDM, New Delhi- 2011.
- 2. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.
- 3. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies ", NewRoyal book Company, 2007.

22AC03

CONSTITUTION OF INDIA

Pre-requisites : Nil

Preamble

Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective. To address the growth of Indian opinion regarding modern Indian intellectuals' Constitutional. Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.

 UNIT 1
 HISTORY ANDPHILOSOPHY OF THE INDIAN CONSTITUTION
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History: History, Drafting Committee, (Composition & Working), Philosophy: Preamble, Salient Features.

UNIT 2 CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT 3 ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT 4 LOCAL ADMINISTRATION

District's Administration head: Role and importance, Municipalities: Introduction, Mayor and roleof Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT 5 ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

Lecture : 30, Tutorial : 0, Total : 30

Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Describe the emergence and evolution of Indian Constitution, structure and composition of Indian Constitution and federalism in the Indian context.
- CO2 Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- CO3 List the functions of Centre, States and District Administrations, Fundamental rights needed to develop human personality in free society.
- CO4 Identify different levels of Panchayat Raj system and its working.
- CO5 Elaborate the role of Election Commission and its power to conduct free and fair election throughout India.

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- 1. The Constitution of India, 1950(Bare Act), Government Publication.
- 2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution, 1st Edition, 2015.
- 3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
- 4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

22AC04

Pre-requisites : Nil

Preamble

The general aims of the course are that the student should acquire knowledge of pedagogical theories of relevance to work with people. Learning outcomes On completion of the course, the student should - describe the basic view of different pedagogical orientations - apply concepts related to learning theory - describe and reflect on different theories of motivation and learning - account for different forms of supervision.

PEDAGOGY STUDIES

UNIT 1 INTRODUCTION

Dimensions of Individual development: Physical, Cognitive, Affective, Social and Moral their interrelationships and implications for teachers - Key Cognitive Processes: Perception, Attention, Memory, Language, Thinking, Problem Solving, Emotions and Motivation. - Stages of Development-Developmental tasks with focus on processes of growth and development across various stages from Infancy to Post Adolescence and their significance to Learning.

UNIT 2 LEARNING THEORIES

Theories of Learning (Concepts, Principles and applicability is different learning situations): -Thorndike, Pavlov, Skinner, Kohler, Guthrie -Piaget, Rogers, Bandura ,Vygotsky - Distinction between learning as Construction of Knowledge and Learning as Transmission and Reception of Knowledge- Meaning of Cognition and its role in learning. Socio-Cultural factors influencing Cognition and Learning -Understanding processes that facilitate Construction of Knowledge : (i) Experiential Learning and Reflection (ii) Social Mediation (iii) Negotiability (iv) Situated Learning and Cognitive Apprenticeship (v) Meta-cognition - Role of a teacher in a teaching-learning context: (a) Transmitter of knowledge (b) Model (c) Facilitator (d) Negotiator (e) Learner.

UNIT 3 OUTCOME BASED EDUCATION

Introduction – Accreditation – Approach to design Outcome based learning – Instructional design for active learning (ADDIE model,etc.,) – Accreditation - Framing Vision, Mission- Graduate attributes, Program outcomes and Program Educational Objectives - Bloom's Taxonomy – Writing Learning outcomes for a course – Assessment and Evaluation – Assessment Methods - Evaluation.

Assignment/ Activity: Course Module development for a course.

UNIT 4 TEACHING AND LEARNING

Traditional Teaching methods- Outcome based Modern teaching methods – Good Teaching Attributes - Active Learning methods (Problem based learning, Cooperative Learning, Focused groups) - Flipped classroom.

Assignment / Activity: Innovative Teaching methods.

UNIT 5 RESEARCH IN EDUCATION

What is educational research – Overview of educational research process – Ethics in educational research-Qualitative research methods and Quantitative research methods.

Lecture : 45, Tutorial : 0, Total : 45

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Course Outcomes: Upon completion of this course, students will be able to:

- CO1 Explain different dimensions of learning
- CO2 Apply suitable learning theory for the class
- CO3 Use outcome based education approaches to their class
- CO4 Exhibit different teaching methods for active learning
- CO5 Apply the concepts and tools of qualitative and quantitative research methods in education.

TEXT BOOKS & REFERENCE BOOKS:

- 1. Dr.V V Rao, "Outcome based education and accreditation", Notion press, 2015
- 2. Mukunda Sarma and Kishor Kumar, "Educational Theories and practices: Towards a new social", Mittal publications, January 2021.
- 3. Dale H. Schunk, "Learning Theories: An Educational Perspective", Springer 2007
- 4. Raymond P Perry , John C Smart, , "Scholarship teaching and learning in Higher education : An evidence based perspective", Springer 2007
- 5. Book chapter by Harry G Murray, "Low inference teaching behaviors and college teaching effectiveness: Recent developments and controversies", 2012