DEPARTMENT OF BIOMEDICAL ENGINEERING

Scheme of Instruction

and

Syllabi of

M.E. (BIOMEDICAL ENGINEERING)

Specialization of

Biomedical Electronics

AICTE Model Curriculum

2020 - 2021

UNIVERSITY COLLEGE OF ENGINEERING

(AUTONOMOUS)

OSMANIA UNIVERSITY

HYDERABAD – 500 007, TELANGANA

M.E. BME (Biomedical Electronics)

Scheme of Instructions

Type of course	Course Code	Course Name	Contact hours per week			Scheme of Examination		Credits
			L	T	P	CIE	SEE	
SEMESTER-I								
Core-I	**BM 101**	Medical Sensors & Signal Conditioning	3	-	-	30	70	3
Core-II	**BM 102**	Embedded Medical Product Design	3	-	-	30	70	3
Program Elective-I	**BM 111**	Medical Instrumentation	3	-	-	30	70	3
	BM 112	Advanced Biomaterials						
	BM 113	Medical Informatics						
Program Elective-II	**BM 114**	Physiology for Engineers	3	-	-	30	70	3
	BM 115	Hospital Administration & Management						
	BM 116	Bioinformatics						
Audit-I	**AC 031**	English for Academic and Research Writing	2	-	-	30	70	0
	AC 032	Disaster Management						
	AC 033	Sanskrit for Technical Knowledge						
	AC 034	Value Education						
Lab-I	**BM 151**	Medical Sensors & Signal Conditioning lab	-	-	3	50	-	1.5
Lab-II	**BM 152**	Embedded Medical Product Design Lab	-	-	3	50	-	1.5
MC	**BM 100**	Medical Research & Ethics	3	-	-	30	70	3
TOTAL			**17**	**-**	**6**	**280**	**420**	**18**
SEMESTER-II								
Core-III	**BM103**	Diagnostic And Therapeutic Equipment	3	-	-	30	70	3
Core-IV	**BM 104**	Advanced Biomedical Signal Processing	3	-	-	30	70	3
Program Elective-III	**BM 117**	Bio Nano Technology	3	-	-	30	70	3
	BM 118	Medical Image Processing						
	BM 119	Biotransport Processes						
	BM 120	Biostatistics						
Program Elective-IV	**BM 121**	Advanced Medical Imaging	3	-	-	30	70	3
	BM 122	Physiological Control Systems						
	BM 123	Electromagnetic Biointeraction						
	BM 124	Enterprise Management						
Audit-II	**AC 035**	Stress Management by Yoga	2	-	-	30	70	0
	AC 036	Personality Development through life enlightenment skills						
	AC 037	Constitution of India						

	AC 038	Pedagogy Studies						
MC	**BM070**	Mini Project	-	-	6	50		3
Lab-III	**BM 153**	Biomedical Signal & Image Processing Lab	-	-	3	50	-	1.5
Lab-IV	**BM 154**	Virtual Instrumentation Lab	-	-	3	50	-	1.5
TOTAL			**14**	**-**	**12**	**300**	**350**	**18**
SEMESTER-III								
Program Elective-V	**BM 125**	Medical Product Design	3	-	-	30	70	3
	BM 126	Lasers In Medicine						
	BM 127	Tissue Engineering						
	BM 128	Medical Optics						
Open Elective	**OE 941**	Business Analytics	3	-	-	30	70	3
	OE 942	Industrial Safety						
	OE 943	Operations Research						
	OE 944	Cost Management of Engineering Projects						
	OE 945	Composite Materials						
	OE 946	Waste to Energy						
	OE947EC	Internet of Things						
	OE948CS	Cyber Security						
	BM 181	Major Project Phase-I	-	-	20	100	-	10
TOTAL			**6**	**-**	**20**	**160**	**140**	**16**
SEMESTER-IV								
	BM 182	Major Project Phase-II	-	-	**32**	**-**	**200**	**16**
GRAND TOTAL						**1850**		**68**

L-Lectures

T-Tutorials

P-Practicals

CIE-Continuous Internal Evaluation

SIE-Semester End Evaluation

BM 101

MEDICAL SENSORS AND SIGNAL CONDITIONING

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 3

Course Objectives:

- To make students to gain knowledge on types and principles of various sensors.
- To make the students understand signal conditioning and noise reduction techniques for different sensors.
- To make the students to apply the sensors to various medical and other applications.

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

1. Understand the classification of sensors and application in medical environment
2. Able to use the capacitive and inductive sensors.
3. Understand the concepts of self-generating sensors, and use them for medical applications
4. Able to measure conductivity, flow rate, acceleration using various sensors
5. Understand the data acquisition, ADC and noise filtering concepts.

UNIT-I

Sensor Classification, Modifying inputs, Functional specifications of medical sensors; static and dynamic characteristics of measurement systems. Primary sensors. Resistive sensors. Potentiometers, Strain gages, RTDs, Thermister, LDR. Signal conditioning. Wheatstone bridge, balance and deflection measurements. Instrumentation amplifier. Interference types and reduction. Shield grounding. Isolation amplifiers. Medical Applications.

UNIT – II

Reaction variation and electromagnetic sensors. Capacitive sensors, inductive sensors, LVDT, electromagnetic sensors. Signal conditioning, AC bridges, AC amplifiers, electrostatic shields, carrier amplifiers, phase-sensitive detectors, Medical Applications.

UNIT-III

Self-generating sensors. Thermoelectric sensors, thermocouples, piezoelectric sensors, photovoltaic sensors. Signal conditioning. chopper and low-drift amplifiers, Noise in op-amps. Digital sensors. Telemetry and data acquisition, Medical Applications

UNIT-IV

Other sensors: Accelerometer transducers, Gyroscopes, Ph sensors, measurement of Conductivity, viscosity, flow transducers, conductivity, Humidity, signal conditioning and Medical Applications.

UNIT-V

Noise reduction techniques. Types of noise, Types of filters for medical applications, Data acquisition, Sample and Hold Conversion, Multi Channel acquisition, Selection of drive amplifier for ADC performance, Gain setting and level shifting, ADC input protection, Types of ADC.

Suggested Reading:

1. John G. Webster, *Medical Instrumentation-Application and Design*, John Wiley and Sons Inc., 3rd Ed., 2003.

2. Richard S.C. Cobbold, *Transducers for Biomedical Measurements: Principles andApplications*, John Wiley & Sons, 1974.

3. Ramon Pallas-Areny and John G.Webster, *Sensors and signal conditioning*, John Wiley and Sons, 1991.

BM 102

EMBEDDED MEDICAL PRODUCT DESIGN

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 3

Course Objectives:

- To make the students learn the concepts of embedded systems, device drivers and memory management.
- To enable the students gain knowledge on the architecture of 8051 and PIC microcontrollers
- To facilitate the students to design basic medical embedded devices

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

1. Understand the concept of an embedded system with different interface and communication protocols
2. Write simple 8051 microcontroller programs in embedded C environment.
3. Design a simple 8051 microcontroller based system through interfacing peripherals
4. Implement simple PIC microcontroller programs in embedded C environment
5. Develop an embedded system through interfacingmedical sensors

UNIT-I: Introduction to Embedded Systems

Embedded system architecture, classification of embedded system, challenges and design issues in embedded systems, skills required for embedded system designer, CISC vs. RISC, Direct Memory access, I/O devices, Serial interfaces-RS-232, 422, 485, Serial Communication Protocols - I2C, SPI, CAN, Bluetooth Protocol, LCD & Keypad Controllers for biomedical applications.

UNIT-II: 8051 Microcontroller

Architecture, Internal and External Memories, Counters and Timers, Register Set, Synchronous and Asynchronous Serial Communication, Interrupts, Instruction Set, Basic C Programming in 8051 Microcontroller, Application of 8051 microcontroller.

UNIT-III: Interfacing with 8051

Memory and I/O interfacing by 8051, ADC, DAC, seven segment display, stepper motor, traffic light control, LEDs, 7 segment LED's, LCD, Touch screen and Keypad interfacing.

UNIT-IV: PIC Architecture

Introduction to PIC microcontrollers, PIC 16F/18F architecture, comparison of PIC with other CISC and RISC based systems and microprocessors, memory mapping, assembly language programming, addressing modes, instruction set. PIC I/O ports, I/O bit manipulation programming, timers/counters, programming to generate delay and wave form generation, I/O programming.

UNIT-V: I/O Programming

Interfacing of medical sensor circuits: Carbon dioxide and oxygen sensors, respiration, force, flow, differential voltage and current probes and humidity sensors. Features, Specifications and their interfacing. Interface pulse-oximeter with PIC & 8051 microcontroller.

Suggested Reading:

1. Dr. K.V.K.K.Prasad, *Embedded Real time Systems*, Dreamtech Press, 2003.
2. Muhammed Ali Mazidi, *8051 Microcontrollers and Embedded Systems*, 2nd Edition, Pearson Pub, 2018
3. Chuck Helebuyck, *Programming PIC microcontrollers with PIC Basic*, Newnes Pub., 2003.
4. Milan verle, *PIC microcontrollers-programming in Basic*, MikroElektronika; 1st edition 2010.

BM 111

MEDICAL INSTRUMENTATION

(Compulsory to EEE & ECE Backgrounds)

Instruction: 3periods per week — Duration of SEE: 3 hours
CIE: 30 marks — SEE: 70 marks
Credits: 3

Course Objectives:

- To introduce the students to the basic concepts of medical instrumentation
- To make the students understand the generation of biopotential signals
- To make the students learn the principles of basic medical instruments

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

1. Explain the generation of biopotential signals and the principles of various sensors
2. Compare the features of display devices used for general and medical applications
3. Differentiate the analytical instruments based on their principle and applications
4. Discuss the recording of ECG and other cardiovascular parameters
5. Discuss the recording of EEG and EMG

UNIT – I

Origin of biopotentials – ECG, EEG, EMG, EOG, ENG, ERG, EGG.
Bio-potential Electrodes: Half cell potential, Offset voltage. Types of External, Internal and Microelectrodes. Electrochemical transducers. Potentiometric sensors, Ampero-metric sensors, Electro-Chemical gas sensors. Biosensors – Enzyme–based biosensors, immuno sensors, microbial sensors.

UNIT – II

Medical display devices and recorders. Basic requirements for the display and recording of biopotential signals. PMMC writing systems, General features of ink-jet, thermo-sensitive and optical recorders, Oscilloscopes- Medical, multi-beam & non-fade display systems.

UNIT – III

Analytical Instrumentation. Methods of Chemical analysis, Absorption, Photometry: Emission photometry, Fluorometry. Chromatography for blood gas analysis. Colorimeters, Spectrophotometers, Electrophoresis, auto analyzer.

UNIT – IV

ECG: Block diagram & circuits, electrode placement, lead configuration, Types of ECG recorders.
Blood pressure measurement: Direct and indirect methods.
Blood flow measurement: Electromagnetic & Ultrasonic techniques.
Heart sounds: Origin, Phonocardiography.

UNIT – V

EEG- Block diagram & circuits, electrode placement, Evoked potentials and their measurement.
EMG-Block diagram & circuits, electrode placement, Nerve conduction velocity determination, EMG stimulators.

Suggested Reading:

1. John G. Webster, Medical Instrumentation-Application and Design, John Wiley and Sons Inc., 3rd Ed., 2003.
2. Khandpur R.S., Hand Book of Biomedical Instrumentation, Tata McGraw Hill Pub Co. Ltd., 2nd ed., New Delhi, 2003.
3. Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson Education, 2001.

BM 112

ADVANCED BIOMATERIALS

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To enable the students to understand the surgical principles of biomaterial implantations.
- To make the students gain knowledge about biocompatibility and biodegradability.
- To make the students learn about surface characterization and applications of biomaterials

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

1. List the requirements for surgical implantation of biomaterials
2. Compare the different levels of biocompatibility and analyze the host reactions
3. Assess different methods of biodegradability
4. Use appropriate methods of surface characterization
5. Describe the applications of biomaterials in various areas of medicine.

UNIT – I

Surgical principles of biomaterials Implantation: Introduction, Principal Considerations for experimental surgical Procedures and Material Selection. Physiological models for evaluation of Implantable Devices-An Engineer's Choice. Implantable Biomaterials in Plastic, Reconstructive and Esthetic Surgery.

UNIT – II

Biocompatibility and Tissue response: Biocompatibility Hierarchy- Ramifications in Implant Design and Applications. Host Reactions to particulate Biomaterials: Type of Reactions, Particle Surface; cell Surface and Signaling Mechanism, Chemical Mediators.

UNIT – III

Biodegradability, Resorption and Stability: Biodegradable suture materials, Factors affecting Biodegradation Phenomena, Intrinsic Factors –Substituent Effect, Morphological Effect, Annealing Effect. Extrinsic Factors – Effect of media pH, Effect of Electrolytes,

UNIT – IV

Physiochemical Characterization of surface and interface on biomaterials and coatings,
Methods of surface characterization, Surface and Interface structure. Investigations- Transmission Electron Microscopy, Ion Beam Techniques. Characteristics of Plasma Gas Discharge. Plasma Systems and Processes.

UNIT – V

Applications of materials in medicine and Dentistry: Cardiovascular Applications, Dental Implants, Orthopedic Applications. Drug Delivery Systems, Sutures, Ophthalmologic Applications.

Suggested Reading:

1. Buddy D.Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, Eds, *Biomaterials Science – An Introduction to Materials in Medicine*, Academic Press, 1996.
2. Donald L. Wise, Debra J. Trantolo, David E. Altobelli, Michael .J. Yaszemski, Joseph D. Gresser, Edith R. Schwartz (Editors), *Hand book of Biomaterials and Bioengineering*, Parts A&B, Marcel Dekker Inc, 1995.

BM 113

MEDICAL INFORMATICS

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To make students understand the approaches in hospital design and medical equipment management.
- To enable the students to have fundamental knowledge of database management and modeling techniques.
- To make students learn hospital information systems and computerization

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

1. Gain knowledge on design and medical equipment maintenance and appreciate the role of biomedical engineer.
2. List the various data structures and data representation.
3. Compare the types of data bases and data modeling techniques.
4. Appreciate the need for computerization of hospital services and records.
5. Evaluate specific test cases.

UNIT-I

Planning and designing of Hospital systems: Financial aspects, Equipment, Building, Organization of the Hospital, various medical services in a Hospital,

BME services and technical aspects: pole and responsibilities. Layout, Setting and Functions of Biomedical Engineering Department in a Hospital .

Biomedical Equipment Management: Procurement process, Training to Medical staff on technical capabilities, Biomedical Equipment maintenance procedures.

UNIT-II

Database Management (DBMS): Introduction to Data structures, Elements, Arrays, Records, Sets, Tables, Singly and Doubly linked Data, Stacks, Queues and Trees, Need for a Database, Architecture of DBMS. Representation of Data, Physical Record Interface

UNIT-III

Data Modeling Techniques: Relational, Hierarchical and Network normalization techniques for Data handling. Relational, Distributed and Other types of Databases. Data Indexing and Structuring Techniques, Integrity and Security of Databases, Information Searching and Retrieval.

Operators: Relational, Logical and Boolean.

UNIT-IV

Hospital Information Systems: Need for Computerization in Hospitals. Functional capabilities of a computerized Hospital Information System. Cost effectiveness of Information processing by a Computer, Security of Computer Records, Source of Data for decision making.

Computerized Patient Database Management: Methods of History taking by Computers, Computerized Medical Record: Evaluation

Computers in Clinical laboratory: Database approach to Laboratory computerization/automation.

UNIT-V

Practice: Case studies- Emergency handling systems, insurance handling, data analysis, IVRS applications, Telemedicine, Equipment maintenance management.

Suggested Reading:

1. G.D. Kunders, *Hospitals Planning, Design and Management*, Tata McGraw-Hill Publications, New Delhi, 2003.
2. Date C.J, *An Introduction to Database Systems*, Addisson Wesley, 1998.
3. 3. J.D Ullman, *Principles of Database Systems*, Galgotia Publications, 1990.
4. R.D.Lele, *Computers in Medicine*, Tata McGraw- Hill Publications, New Delhi, 1988.

BM 114

PHYSIOLOGY FOR ENGINEERS

(Compulsory to students with EEE, E&EI & ECE Back grounds)

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 3

Course Objectives:

- To make the students understand the cellular mechanisms.
- To enable the students to have fundamental knowledge of physiological system function and dysfunction.
- To make students analyze physiological systems from an engineering perspective.

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

1. Gain knowledge on the functioning of nerve and muscle cells.
2. Appreciate the cardiovascular system and the dynamics of circulation.
3. Explain the respiratory mechanism and the transport of gases in blood.
4. Identify the functions of the renal system and temperature regulation.
5. Recognize the functions of the different parts of the brain.

UNIT – I

A. General Physiology: Introduction-Evolutionary aspects and thermodynamics of living systems. Cellular physiology-digital and analog molecules and patterning of activity, active and passive process, optimization principles, macromolecular self assembly, molecular homeostasis. DNA, RNA, chromosomes, Gene. Genetic inheritance and epigenetics. Gene expression and its regulation: Endogeneous feed-forward circuitry and stochastic models. Intracellular physiology-structure and function. Transport across cell membrane.

B. Nerve Physiology: Genesis of membrane potentials, Nernst equation, Goldman-Katz equation, cable properties, local, analog signaling. Action potentials, Digital/propagative signaling. Hodgkin-Huxley model, differential equation of action potentials. Electrophysiology of cell membrane, experimental studies(Voltage clamp and patch clamp methods)

C. Muscle Physiology: Types of muscle fibers-Structure and function. Neuro-muscular junction, Excitation-contraction coupling, Molecular basis of muscle contraction, motor UNIT and muscle contraction. Smooth, cardiac and skeletal muscles, Biophysics of musculoskeletal systems, Experimental study of electrical activity.

UNIT – II

Cardiovascular system: Introduction to cardiovascular physiology. Functional anatomy of heart and vessels. Electro Physiology of heart. Electrocardiogram and magneto cardiogram. Cardiac cycle. Blood as a non-Newtonian fluid. Dynamics of circulation, regional circulations. Cardiac output and methods of estimation. Control systems; neural and humoral regulation. Applied aspects.

UNIT – III

Overview of respiratory physiology. Ventilation, Biophysics of transport across respiratory membrane. Perfusion and diffusion limited process. Ventilation, alveolar, shunt and dead space equations. Ventilation perfusion inequalities. Biophysics of transport of gases in blood. Applied aspects.

UNIT – IV

Renal system: Overview of renal physiology. Clearance equation and biophysics of filtration, reabsorption and secretion. Counter-current multiplication and exchange, acid base balance, Regulation of body temperature. Applied aspects. Endocrine and Reproductive systems.

UNIT – V

Neurophysiology: Overview, sensory system, signal generation, conduction processing and transduction. Synapse, signal integration at spinal cord, brain stem, sub-cortical and cortical levels. Motor systems, planning, programming and execution. Cognitive functions. Language, speech, thought, sleep, learning and memory. Experimental study of electrophysiology. Near field and far field potentials, EEG, Nerve conduction studies and evoke potentials.

Suggested Reading:

1. Best and Taylor, Physiological basis of Medical practice, *The Living Body*, B.I. Publication, 1980.
2. Mount castle Textbook of medical physiologyBetter World Books, IN, USA
3. Walter F. Boron, Textbook of medical physiology, W.B. Saunders Company
4. Zipes, Jalife, Cardiac Electrophysiology
5. Eric R. Kandel, Principles of Neural Science, Elsevier science division
6. Un Kimura, Electrodiagnosis in diseases of nerve and muscle, W.B. Saunders Company.

BM 115

HOSPITAL ADMINISTRATION & MANAGEMENT

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 3

Course Objectives:

- To make the students know the about the administration of all the departments in the hospitals.
- To make the students understand hospital planning and information management.
- To make the students learn about equipment maintenance management.

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

1. Explain the significance of various departments present in the hospital
2. Analyze the planning of location, budgeting and other facilities in a hospital
3. Recognize the role of computerization in a hospital
4. Evaluate the power supply requirements for various services and equipments in a hospital
5. Schedule the routine preventive maintenance procedures and maintain log books

UNIT – I

Administration of Hospital Systems: Teaching-cum-Research Hospitals. General Hospital. Specialist Hospitals. P.H.C. – Role, Layout and Functions. Hospital Services: Emergency; Outpatient; supporting; auxiliary; Dietary; Drugs and Medical Supply. Nursing Services. Records Management.
BME Services in Hospitals: Role and Responsibilities

UNIT – II

Hospital Planning. Technical Considerations: Size and kind of Hospitals; Principles of Planning – Selection; Location; Site and Orientation. Budgeting, Equipment Plans. Power Supply. Air-conditioning and Water Supply requirements. Elevators, Ambulance, Fire Fighting and Safety services. Disposables. Hospital Infection and Control.

UNIT – III

Computers and Information Management in Hospitals: Computer Aided Hospital management – Applications: Admission/Discharge Records. Patient Billing. In-patient medical records. Pharmacy Management. Operation Theaters and ICCU. OPD Registration, Purchase and Inventory Control.

UNIT – IV

Electrical factors in Hospital Design, Layout and Centralisation of Technical Services: Electrical Power Supply: Reliability, Three Phase Systems. Voltage stabilisation. Proper location of Air Conditioners, Elevators, Transformers, other electrical machinery and Electrical Shielding techniques to prevent 50Hz power supply interference on sensitive Electro Medical / Diagnostic / Monitoring / Therapeutic Equipment. Standby power supply arrangements.Centralisation: Commonality of technical services and centralisation for optimum utility of equipment and staff. Efficient operation and cost effectiveness.

UNIT – V

Bio-Medical Equipment Maintenance Management: Procurement Procedures: Proper Selection, Safety, Spares, Evaluation, Testing and Installation. Purchase and Contract Procedures. Training of medical staff on technical capabilities and proper use of Biomedical equipment.Biomedical Equipment Maintenance: Procedures & Policy, Mandatory Requirements. Maintenance Procedures.Preventive Maintenance and Periodical Servicing Procedures: Servicing Schedules. Fault Diagnosis. Repairs and Modifications. Maintenance of LogBooks. Implementation of Electrical Safety Codes and Standards, Stores Management. Functional Organisation of a BME/Clinical Engineering Department. Layout and Setting of Clinical Engineering Lab, Workshop. Test and Servicing Equipment. Staff, In-house R & D.

Suggested Reading:

1. Goel S.L., and Kumar R., *Hospital Administration and Management* Vol. 1,2,3, Deep and Deep, New Delhi.
2. G.D. Kunders, *Hospitals Planning, Design and Management*, Tata McGraw-Hill, 2003.

BM 116

BIOINFORMATICS

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To give students an introduction to the basic techniques of bioinformatics.
- To make the students develop bioinformatics programs for comparing &analysing biological sequence data.
- To make the students understand the computational challenges and their solutions in the analysis of large biological data sets.

Course Outcomes: Upon completion students will be able to

1. Explain the major steps in pairwise and multiple sequence alignment, explain the principle and execute pairwise sequence alignment by dynamic programming.
2. Predict the secondary and tertiary structures of protein sequences.
3. Work with commonly used bioinformatics tools for analyzing the data.
4. Implement bioinformatics tools in understanding protein structures. Understanding the classification of protein databases.
5. Implement machine learning algorithms for classification and prediction of protein sequences.

UNIT I

Prediction of protein molecular function and structure: Primary sequence of a protein and its analysis, Secondary, Tertiary and quaternary structures and their prediction methods, Fold recognition methods, Homology /comparative modeling of proteins, Energy calculations, local and global minimization, Energy Minimizations: Conjugate, steepest and Powell, Molecular dynamics and simulation studies.

UNIT II

Algorithms: Algorithms and complexity, Biological algorithms, computer algorithms. The change problem, Correct, incorrect algorithms, Recursive algorithms, Iterative, recursive algorithms, Fast and slow algorithms, Big-O notation, Algorithm designing techniques- Exhaustive search, Branch-and-bound algorithms, Dynamic programming, Divide-and-conquer algorithms, Randomized algorithms, Gibbs sampling.

UNIT III

Computer algorithms for prediction of protein structures. DNA Sequence Comparison, Algorithms for alignment of sequences and structures of proteins and protein families, PAM, BLOSUM, Bayesian modeling and networks, Probabilistic models or Hidden Markov models, Needleman Wunch and Smith Waterman algorithms, Global sequence alignment, Scoring alignments, Local sequence alignment, Alignment with gap penalties. Multiple alignment, Gene prediction-Statistical and Similarity-based approaches. Spliced alignment.

UNIT IV

Genetic algorithms: Genetic algorithms for the prediction of multiple sequence alignment, Gene expression analysis, Hierarchical clustering, K-Means clustering, clustering and corrupted cliques. Evolutionary trees-Distance-based tree reconstruction, Reconstructing trees from additive matrices, Evolutionary trees and hierarchical clustering. Character-based tree reconstruction- Small parsimony problem, large parsimony problem.

UNIT V

Neural Networks: Biological neurons and neural networks. Networks of artificial neurons. Learning in single layer and multi-layer perceptrons. Back-propagation. Radial basis function networks: Algorithms and applications. Committee machines. Self-organizing maps: algorithms and applications. Learning vector Quantization. Machine Learning, Statistical learning, Decision trees. Inductive logic programming, Computation learning, Unsupervised learning, temporal difference learning, Delayed reinforcement learning, Explanation based learning.

Suggested Reading:

1.Bioinformatics – *Sequence and Genome Analysis*. David W. Mount.

2.Beale and T.J. Jackson, *Introduction to Neural Networks*, IOP Publishing Company, 1990.

3.Baeck, D.B. Fogel and Z. Michalewicz,*Genetic Algorithms*, IOS Press, 1997.

AC 031

ENGLISH FOR ACADEMIC AND RESEARCH WRITING

Instruction: 2 periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 0

Course Objectives: To expose the students to

- Features of Academic writing; different kinds of Academic writing
- Some academic writing skills; the research process; the structure of a research document

Course Outcomes: At the end of the course, the students would be equipped with knowledge and skills related to

1. Academic writing features; Academic writing kinds; Important academic writing skills
2. The process of research; general research document structure

UNIT I: Features of Academic Writing
Language: Clear, Correct, Concise, Inclusive; **Tone**: Formal, Objective, Cautious;
Style: Appropriate, Accurate, Organized; **Ethics**: Honesty, Integrity, Responsibility, Accountability

UNIT II: Kinds of Academic Writing
Essays, Reports, Reviews, Abstracts, Proposals

UNIT III: Academic Writing Skills
Paraphrasing; Summarizing; Quoting; Rewriting; Expansion

UNIT IV: **Research Process**
Selection of Topic, Formulation of Hypothesis, Collection of Data, Analysis of Data, Interpretation of Data, Presentation of Data

UNIT V: Structure of a Research Document
Title, Abstract, Introduction, Literature Survey, Methodology, Discussion, Findings/Results, Conclusion, Documenting Sources (IEEE style)

Suggested Reading

1. Bailey, S. (2014). Academic writing: A handbook for international students, Routledge.
2. Gillett, A., Hammond, A., & Martala, M. (2009). Inside track: Successful academic writing. Essex: Pearson Education Limited.
3. Griffin, G. (2006). Research methods for English studies. Edinburgh: Edinburgh University Press.
4. Silyn-Roberts, Heather. (2013). Writing for Science and Engineering: Papers, Presentations and Reports(2nd ed.). Elsevier.
5. Lipson, Charles (2011). Cite right: A quick guide to citation styles; MLA, APA, Chicago, the sciences, professions, and more (2nd ed.). Chicago [u.a.]: University of Chicago Press.

AC032

DISASTER MANAGEMENT

Instruction: 2 periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 0

Course Objectives:

- To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
- To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
- To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.

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

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction
2. Humanitarian response
3. Critically evaluate disaster risk reduction and humanitarian response policy and Practice from multiple perspectives.
4. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
5. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

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

UNIT-II
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-III
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-IV
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-V

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.

UNIT-VI

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster
Mitigation in India.

Suggested Readings:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.), "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L. Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

AC 033

SANSKRIT FOR TECHNICAL KNOWLEDGE

Instruction: 2 periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 0

Course Objectives:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects
- enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

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

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

UNIT-I

- Alphabets in Sanskrit,
- Past/Present/Future Tense,
- Simple Sentences

UNIT-II

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

UNIT-III

- Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Reading:

1. "Abhyas pustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumb shastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

AC 034

VALUE EDUCATION

Instruction: 2 periods per week
CIE: 30 marks
Credits: 0

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives

Students will be able to

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

COURSE OUTCOMES:

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

UNIT-I

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgments

UNIT-II

- Importance of cultivation of values.
- Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity. Power of faith, National Unity.
- Patriotism. Love for nature, Discipline

UNIT-III

- Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.

UNIT-IV

- Doing best for saving nature
- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Suggested Reading:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University, Press, New Delhi

BM 151

MEDICAL SENSORS AND SIGNAL CONDITIONING LAB

Instruction	3 Periods per week
CIE	50 Marks
Credits	1.5

Course Objectives:

- To make the students conduct experiments using various sensors.
- To make the students design signal conditioning circuits for different sensors and implement them for medical applications.

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

1. conduct experiments on self-generating sensors, and use them for medical applications
2. Able to measure conductivity, flow rate, acceleration using various sensors
3. Design the data acquisition system with ADC and filters for different sensors.

1. Experiments on Electrodes- ECG, EEG, EMG

2. Signal conditioners for the following transducers:
   - (i) Piezoelectric transducers
   - (ii) Thermocouple
   - (iii) Phonocardiography transducer
   - (iv) Strain gauge
   - (v) LVDT
   - (vi) Plethysmographic transducer
   - (vii) Capacitive transducer
   - (viii) Electromagnetic flow transducer
   - (ix) Optical transducer
   - (x) Carrier Amplifier
   - (xi) Chopper Amplifier
   - (xii) Isolation Amplifier
   - (xiii) MEMS Sensors

BM 152

EMBEDDED MEDICAL PRODUCT DESIGN LAB

Instruction	3 Periods per week
CIE	50 Marks
Credits	1.5

Course Objectives:

- To make the students know the basic concepts of embedded systems, device drivers and memory management.
- To make the students write programs to interface various peripheral devices with 8051 and PIC microcontrollers

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

1. Understand the functionality of 8051 and PIC microcontroller
2. Interface various peripheral devices with 8051 and PIC microcontrollers
3. Interface matrix sensors to PIC microcontroller

Study of different microcontroller development systems. Interface 8051 microcontroller with :

1. ADC
2. DAC
3. Keyboard interface & Touch screen
4. LCD Display: Alphanumeric mode & Graphic mode
5. Seven segment display
6. PC interface: RS 232
7. PC interface: Ethernet
8. Stepper motor
9. I2C based EEPROM interfacing
10. SPI based EEPROM interfacing
11. Interfacing of matrix sensors to PIC microcontroller
    a) Pin to pin study of MCU
    b) To study of initialization of internal fix PWM
    c) To study of Initialization of internal PWM with variable duty cycle using Internal ADC
    d) ECG sensor
    e) Oxygen sensor
    f) Heart rate monitor

Note:

The experiments to be conducted under this lab should include design/fabrication/ evaluation/technical reporting/case-studies/mini projects. The students should be encouraged to take up different challenging mini projects in this lab.

BM 100

MEDICAL RESEARCH & ETHICS

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To inculcate research temper in students
- To introduce the students to research approaches and techniques of problem formulation.
- To enable students to gain knowledge on literature review, data collection, data analysis and report writing.

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

1. Appreciate the importance and types of research and define a research problem.
2. Conduct a literature survey, prepare a research review and present a research design
3. Compare and select the correct source and technique for data collection following ethical principles.
4. Analyze the data collected using statistical relevant statistical techniques
5. Summarize the data analysis in the form of technical report and understand relevant standards and regulations.

UNIT - I

Research Methodology: Introduction to Clinical Research, Objectives and Motivation of Research, Types of Clinical Research, Research Approaches, Significance of Research, Research Methods verses Methodology, Principle of GCP, Problems Encountered by Researchers in India, Benefits to the society in general.

Defining the Research Problem: Definition of Research Problem, Problem Formulation, Necessity of Defining the Problem, Technique involved in Defining a Problem.

UNIT - II

Literature Survey: Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet.

Literature Review: Need of Review, Guidelines for Review, Record of Research Review.

Research Design: Need of Research Design, Feature of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Design of Experimental Set-up, Use of Standards and Codes.

UNIT - III

Data Collection: Collection of primary data, Secondary data, Protocol Development ,Patient Information Sheet & Informed Consent Form, Source Data & Case Reports Forms, Standard Operating Procedures, Subject Selection, Recruitment & Retention, Clinical Trial Designs ,Randomization & blinding in Clinical Trials, Roles & Responsibilities of IEC ,Monitoring & Auditing of Clinical Trials, standard databases for medical data.

Medical ethics: Moral Problems in Medical Ethics / Bioethics, Principles & Challenges in Medical Ethics, Ethical Guidelines for conducting clinical trials in Humans, Essential documents for conducting clinical research.

UNIT-IV

Data Analysis: Role of Statistics for Data Analysis, Parametric V/s Non-Parametric methods, Descriptive Statistics, Measures of central tendency and Dispersion, Hypothesis testing, Use of Statistical software. Deterministic and random data, Uncertainty analysis, Tests for significance: Chi-square, student's t-test, Regression modeling, Direct and Interaction effects, ANOVA, F-test, Time Series analysis, Autocorrelation and Autoregressive modeling.

UNIT - V

Research Report Writing: Format of the medical Research report, Synopsis, Dissertation, writing a Research Proposal and Research Report, funding agencies for medical research.

Medical device regulations and standards: Food and Drug Administration, Medical device directives, ISO 9001 series of standards, Domestic standards, International standards.

Suggested Reading:

1. Peter Agger, Robert S. Stephenson, J. Michael Hasenkam, A Practical Guide to Biomedical Research: for the Aspiring Scientist,Springer international publishers, 2017.
2. Biomedical Research Methodology:Including Biostatistical Applications Paperback – 2011by Ranjan Das
3. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers, 2004
4. Y.P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling Publs., Pvt., Ltd., New Delhi, 2004
5. Richard C.Fries, *Handbook of medical device design*, Marcel Dekker Inc., 2001.

BM 103

DIAGNOSTIC AND THERAPEUTIC EQUIPMENT

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 3

Course Objectives:

- To make the students understand the operating principles of a wide range of Biomedical Equipment.
- To familiarize the students with the operating principles of the equipment.
- To enable the students to gain knowledge on the applications of various medical equipment.

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

1. Assess use of electrical stimulation principles to overcome cardiac rhythm disturbances and principles of Defibrillator.
2. Comprehend the principles of Anesthesia machine, functions of respiratory equipment and ventilators and sterilization equipment.
3. Assess the need and operating principle of equipment used in audiometry, Neonatology and drug delivery.
4. Comprehend the principles of Hemodialysis machine, Lithotripter and Endoscopy.
5. Perceive the governing principles of surgical diathermy and radiotherapy

UNIT – I

Cardiac Pacemakers - Need for Cardiac Pacemaker, Principle of operation, Classification of pacemakers, Cardiac Defibrillators -Need for a Defibrillator – Types of Defibrillator - Defibrillator analyzer. Cardiac Valves, different types Mechanical and Tissue types. Angioplasty. Balloon and Stent Angioplasty., Stents, different types – coil, slotted tubular, drug eluting stents.

UNIT-II

Need for Anesthesia – Anesthesia machine - Electronics in Anesthesia machine.
Ventilators - Need for a Ventilators, Classification of Ventilators, High frequency ventilators, CPAP, BiPAP, Humidifiers, Nebulizers and Aspirators, Heart Lung machine. Sterilization techniques: Autoclave, Gas, Dry Heat, Radiation, Dry Steam sterilization

UNIT – III

Audiometry: Common tests and procedures, audiometer.
Hearing Aids: Different types, comparison of microphones receivers and amplifiers, cochlear Implants. Neonatal instrumentation: incubators, apnea monitor, photo-therapy devices. Syringe Pump, Infusion Pump.

UNIT – IV

Haemodialyzers - Artificial Kidney, Dialyzers, principle of dialyzers, Membranes of the haemodialyzers, Types of Dialysis and merits and demerits.
Lithotripters - need of lithotripsy, types of lithotripter systems, techniques, applications and limitations. Endoscopy, Laparoscopy, Keyhole surgery

UNIT – V

Clinical applications of electrotherapy, principle of surgical diathermy, surgical diathermy machine, safety aspects in Electro-Surgical diathermy Unit, short wave diathermy, ultrasonic diathermy, microwave diathermy, Pain relief through Electrical Stimulation Principles of Cryogenic technique and application,
Radio Therapy: Principles of radiotherapy, Cobalt UNIT, Treatment planning system. Types of radiation detectors, biological effects of radiotherapy.

Suggested Reading:

1. John G. Webster (Editor-in-Chief), Encyclopedia of Medical Devices and Instrumentation Vol.1 to Vol.4, John Wiley and Sons, 1988.
2. Khandpur R. S., Handbook of Bio-Medical Instrumentation, Tata McGraw Hill, 2nd Ed., 2003.
3. Joseph Bronzino (Editor-in-Chief), Handbook of Biomedical Engineering, CRC Press, 1995.
4. Harry Bronzino E, Handbook of Biomedical Engineering and Measurements, Reston, Virginia.
5. Joseph J.Carr and John M.Brown, Introduction to Biomedical equipment technology, John Wiley and sons, New York, 1997

BM 104

ADVANCED BIOMEDICAL SIGNAL PROCESSING

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 3

Course Objectives:

- This course facilitates the students to understand the design of filters for bio signals.
- They learn the Feature extraction methods of various bio signals like EG, EEG, HRV.
- This course enables the students to learn algorithms required for the automated diagnosis of various cardiovascular and neuro-muscular disorders.

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

1. Design filters for the pre-processing of Bio signals.
2. Able to apply wavelet transforms for the bio signals.
3. Understand and implement features extraction of ECG and HRV signals.
4. Able to analyze the EEG and EMG signals by using Time and frequency domain analysis.
5. Comprehend the concept of brain computer interface and built some applications.

UNIT-I Fundamentals of Discrete-Time signals and systems

Concepts of signal, system, Sampling Process, Impulse Response, Z-Transform, Discrete Transfer function, Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT), Short time Fourier Transform, Autocorrelation and cross correlation functions, Cross correlation coefficient, cepstrum analyzer, medical applications.

UNIT-II Wavelets and applications

Continuous Wavelet Transform, Discrete wavelet transform, Recursive multi resolution decomposition Reconstruction, Types of wavelets-Haar wavelet, Daubechies wavelet, Biorthogonal wavelet,Coiflet wavelet, Morlet wavelet, Mexican Hat wavelet, Symlet wavelet, De-noising of physiological signals, Medical Image fusion, Wavelet based compression methods.

UNIT-III Cardiac signal processing (ECG)

ECG characteristics, sources of Noise (Baseline Wander, Power line interference, Muscle Noise Filtering and Artifacts), Preprocessing techniques, QRS Detection techniques, Wave Delineation, Data Compression, Heart Rate Variability, Spectral Analysis of Heart Rate Variability, Adaptive Noise cancellation, and applications.

UNIT-IV Neuro Muscular signal processing (EEG & EMG)

Characteristics of EEG and EMG, Evoked Potential Modalities Sources of Noise and artifacts in EEG recording, Preprocessing techniques, Noise reduction by Ensemble Averaging and Linear Filtering, Linear prediction theory, Auto regressive method, levinson algorithm, Model based analysis of EEG, EEG segmentation, Joint Time-Frequency Analysis, Spectral analysis, Modeling the EMG,Amplitude Estimation in the surface EMG, Spectral Analysis of the surface EMG

UNIT-V ICA & PCA Applications.

Geometry of mixing and un mixing, methods for blind source separation, Gaussian distribution, Probability density function, mean, covariance, kurtosis, negentropy, and applications of ICA, including voice mixtures, EEG, fMRI, and fetal heart monitoring. PCA and applications, EMD process and applications.

Suggested Reading:

1. Leif Sornmo and Pablo Laguna, Bioelectrical Signal Processing in Cardiac and Neurological Applications, Academic Press, 2005
2. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice-Hall, 1993.
3. RangarajM.Rangayyan, AkayMetin(Editor),Biomedical Signal Analysis: A Case Study Approach, Wiley Inderscience, 2001.
4. James V. Stone, Independent Component Analysis: A Tutorial Introduction-MIT press, 2004.

BM 117

BIO NANO TECHNOLOGY

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 3

Course Objectives:

- To introduce the students to fabrication processes of MEMS and NEMS.
- To make the students learn the properties, characteristics, classification and applications of Nano devices.
- To make the students understand the importance of Nano materials and their medical applications.

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

1. Explain the fabrication and applications of MEMS and NEMS
2. Compare the bottom-up and top-down approaches in nanomaterials fabrication.
3. list the types of of Carbon nanoparticles nanotubes and their fabrication
4. Describe the applications of Nanomaterials in cancer treatment, drug delivery and imaging applications.
5. Explainthe biosensor applications of Nanomaterials.

UNIT-I MEMS & NEMS:
Definition of MEMS, materials for MEMS (Silicon, Polymers and metals) and their properties, Deposition processes, Photolithography, and etching processes, Limitations of MEMS, NEMS, difference between MEMS and NEMS, properties of NMES, fabrication processes, applications.

UNIT-II Introduction to Nanotechnology:
Nanomaterials, Fullerenes and carbon forms. Nanoparticles and Colloids, structure and bonding in nanoparticles, Nanomaterials fabrication by Bottom-up and Top down approaches, Classification of nanodevices based on the characteristics, Quantum dots and their properties.

UNIT-III Carbon Nanotubes:
Carbon nanoparticles, types of carbon nanotubes, single-walled, multi-walled, torus, nanobud, properties of carbon nanotubes, and synthesis by Arc discharge, laser ablation, chemical vapor deposition techniques

UNIT-IV Nanomedicine:
Medical use of Nanomaterials, Drug delivery systems. Cancer treatment, Surgery. Drug tracking systems. Targeted drug delivery systems. Applications of Nanomaterials in Medical imaging. Neuro-electronic interfaces.

UNIT-V Bio molecular nanotechnology:
Nanorobots and their application, nanosensors based on biomolecules such as DNA and proteins, nanoparticles for gene delivery systems, Computational genes, Biosensors for Glucose and measurement, Optical biosensors and their application.

Suggested Reading:

1. Lynn E. Foster, Foreword by George Allen, Foreword by Joe Lieberman, Nanotechnology: Science, Innovation, and Opportunity, Nanomedicine: Basic Capabilities, Vol. 1 by Robert A. Freitas Jr. 1999 Rev
2. NeelinaMalsch, Biomedical nanotechnology by CRC press release, *MalschTechnoValuation, Utrecht, The Netherlands*
3. GeroDecher, Joseph B. Schlenoff, Multilayer Thin Films, Wiley-VCH Verlag GmbH & Co. KGaA, 2003
4. David S. Goodsell, Bionanotechnology: Lessons from Nature, Wiley-Liss, 2004.
5. Kenneth J. Klabunde, Nanoscale Materials in Chemistry. , John Wiley & Sons, Inc., 2001

BM 118

MEDICAL IMAGE PROCESSING

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To make the students have clear understanding on the principles of Digital Image processing.
- To make students learn and understand image enhancement in spatial and frequency domain.
- To familiarize the students with the image restoration and segmentation algorithms.

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

1. Understand the mathematical foundations for digital manipulation of images and image acquisition process.
2. Comprehend the principles of image preprocessing.
3. Perceive the governing principles of image segmentation.
4. Evaluate the image restoration and registration methods.
5. Realize how to implement morphological principles to the medical images.

UNIT-I

Digitized image functions, Dirac distributions, convolution, Fourier transform, Images as linear system. Image digitization, sampling, Quantization, color images. Digital image properties, Metric and topological properties, Histogram visual perception, Image quality, Noise. Data structures for image analysis, data representation, traditional and hierarchical data structures.

UNIT-II

Image Enhancement. Contrast manipulation, histogram equalization, Laplacian derivatives, Sobel and Klisch operators, rank operators –textural analysis. Image pre processing – pixel brightness transformations, Geometric transformations, local pre processing, Image restoration. Imaging filters.

UNIT-III

Thresholding and Segmentation. Detection methods, optimal thresholding, multi-spectral thresholding. Edge based segmentation, Region based segmentation, Matching, Advanced optimal border and surface detection approaches.

UNIT-IV

Restoration. Deterministic, geometric linear filtration, inverse filtering, power spectrum equalization, stochastic. Wiener filtering. Registration, anatomy based, object based, scene based.

UNIT-V

Mathematical morphology. Basic morphological concepts, Morphological principles: Binary dilation and erosion, Gray scale dilation and erosion, skeletons and object marking, graundometry, Morphological segmentation and water sheds.

Suggested Reading:

1. John C Russ, *The image processing handbook*, CRC and IEEE press –1999.
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, *Image processing, analysis and machine vision*, 2nd edition, Brooks/Cole publishing Co., 1999.
3. Jayaram, Kudupa and Gabor, T Herman, *3D imaging in medicine*, 2nd edition, CRC press, 2000.
4. Craig A. Hindley, *Practical image processing in C*, John Wiley and Sons 1991.

BM 119

BIO-TRANSPORT PROCESSES

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 3

Course Objectives:

- To introduce the students to the mass and heat transport processes in the human body
- To make the students understand mass transfer mechanisms in artificial kidneys and lungs
- To make the students gain basic knowledge of compartmental models and their physiological applications

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

1. Understand the basic laws governing mass and heat transport
2. Discuss the mechanisms for heat transfer in the human body
3. Analyze the mass transfer in the kidneys and lungs
4. Apply mass transfer principles to artificial kidneys and artificial lungs
5. Describe the one- and two- compartmental models and their physiological applications

UNIT- I

Basic concepts of transport processes. Relationship between flow and effort variables. Chemical balances, force balances, general flow balances, Kirchhoff's laws, Conservation of mass, conservation of energy, momentum balance.

UNIT- II

Heat transfer systems. Modes of heat transfer, conduction, convection and radiation. Heat production, heat loss to the environment, role of blood circulation in internal heat transfer, models for heat transfer within the body.

UNIT- III

Mass transfer principles. Mass balance, molecular diffusion, Transport through cell membranes. Mass transfer in kidneys, models of nephron function, gas transport mechanisms in the lungs and blood. Modelling of oxygen and inert gas uptake in the lungs.

UNIT- IV

Mass transfer in artificial kidney devices, modeling of patient-artificial kidney system. Comparison of natural and artificial lungs. Models for blood oxygenation, analysis of gas transport in membrane oxygenators.

UNIT- V

Compartmental models. Approaches to pharmacokinetic modeling and drug delivery, one and two compartmental models. Physiological applications-intravenous injection, constant intravenous infusion, determination of regional blood flow volumes and blood flow rates.

Suggested Reading:

1. Arthur T. Johnson, Biological process Engineering- An analogical approach to fluid flow, heat transfer, mass transfer applied to Biological systems, John Wiley and Sons, 1999.
2. David O. Cooney, Biomedical Engineering Principles-An introduction to fluid, heat and mass transport processes, Marcel Dekker Inc., 1976.

BM 120

BIOSTATISTICS

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To introduce basic statistical methods like curve fitting, correlation and regression.
- To provide the knowledge of probability distributions like normal, Poisson and tests of significance.
- Recognize the importance of data collection and its role in determining scope of inference.

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

1. Apply various probability distributions to solve practical problems,
2. Estimate unknown parameters of populations and apply the tests of hypotheses.
3. Analyze variance to randomize.
4. Perform regression analysis and to compute and interpret the coefficient of correlation.
5. Carry out the chi-square test and interpret its results.

UNIT- I

Concepts of Biostatistics. Basic statistical measures, measures of central tendency, measures of dispersion, variance, standard deviation, properties of probability, probability distributions, sampling distributions.

UNIT- II

Estimation and hypothesis testing. Confidence intervals for data, t distribution, determination of sample size for estimating means and proportions. Hypothesis testing for a single population mean/proportion difference between two population means/proportions, sample size to control type I and type II errors.

UNIT- III

Analysis of variance. The completely randomized design, random sized complete block design, repeated measures design.

UNIT- IV

Regression and correlation. Simple linear regression model, regression equation, the correlation model, multiple linear regression model, multiple regression equation, multiple correlation model, additional techniques of regression analysis.

UNIT- V

Chi-square distribution, tests of good fit, independence, homogeneity, non-parametric statistical procedures, regression analysis.

Suggested Reading:

1. Stanton A. Glantz, *Primer of biostatistics,* Mc GrawHill , 2nd Ed.
2. Wayne S. Daniel, *Biostatistics: A foundation for analysis in the health sciences*, John Wiley & Sons, 6th Ed. 2012.

BM 121

ADVANCED MEDICAL IMAGING

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 3

Course Objectives:

- To make the students learn physical principles of medical Imaging equipment.
- To make the students understand image reconstruction techniques.
- To make the students gain knowledge on the medical applications of imaging modalities.

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

1. Explain the principle and components of X-ray imaging system.
2. Describe an angiography system and its applications
3. List the principle and applications of MRI Scan
4. Interpret principles and applications of ultrasound scanner
5. Understand the concepts of nuclear medicine

UNIT-I

X ray Imaging: Introduction to Electromagnetic spectrum and their properties, Production of X-rays-X-ray tubes-Insert housing, filtration, grid, and collimation, -X-ray generator circuit design - Image production. Computed radiography Charge coupled device flat panel detectors - Direct and Indirect detection. Fluoroscopy - Chain components - peripheral equipment - Flat panel digital fluoroscopy

UNIT-II

Basics of digital angiography - Image processors for digital angiography - processor architecture - Digital subtraction angiography. Mammography - X-ray tube design - X-ray generator and photo timer system - Image production. Digital mammography - X-Ray computed tomography - Basic principles To mographic acquisition and reconstruction-Historical Development - scanner - image formation principles - conversion of x-ray data in to scan image - 2D image reconstruction techniques - Iteration and Fourier methods. Applications - CT Angio, Osteo, Dental, Perfusion (Body & Neuro), Virtual Endoscopy, Coronary Angiography).

UNIT-III

Magnetic Resonance Imaging: Introduction - principles of MRI - MRI instrumentation, magnets - gradient system - RF coils and receiver system. Relaxation processes, pulse sequence, image acquisition and reconstruction techniques, Image acquisition in magnetic resonance imaging - T1, T2, proton density weighted images, Artifacts in imaging Various types of pulse sequences for fast acquisition of imaging. Functional MRI - The BOLD effect - intra - and extra vascular field offsets, source of T2* effects, Creating BOLD contrast sequence optimization Sources and dependences of physiological noise in FMRI.

UNIT-IV

Ultrasound Scanner: Physics of ultrasound - Principles of image formation - Capture and display, Basic Ultrasound instrumentation, Imaging techniques and their modes of operation (A mode, B Mode, 2B, B/M, 4B, Gated Mode, 3D, 4D, M-Mode, Echocardiography).Design of scan converters, Design of frame grabbers. High line and low line monitoring of ultrasound displays. Doppler Ultrasound and Color flow mapping of scan conversion (real time imaging) - image processing. Image artifact, Biological effects and Application in medicine

UNIT-V

Nuclear Medicine - Radionuclide production - radiopharmaceuticals - Mechanism of localization - Physics of Gamma camera, basic Instrumentation, Anger scintillation camera - Design principles of operation - Image formation. Emission Tomography imaging - SPECT - Image acquisition and reconstruction - PET - Design and principles of operation - Two and three dimensional data acquisition - comparison of SPECT, PET and combined PET/ X-ray CT.

Suggested Reading:

1. S Webb, "The Physics of Medical Imaging", Adam Highler, Bristol Published by CRC Press, 1988

2. A C Kak, "Principle of Computed Tomography", IEEE Press New York, 1988

3. Hykes, Heorick, Starchman, Ultrasound physics and Instrumentation MOSBY year book, 2nd Ed., 1992.

4. Stewart C.Bushong, Magnetic Resonance Imaging- physical and biological principles, MOSBY, 2nd Ed., 1995.

5. Zhi-Pei Laing and Paul C.Lauterbur, Principles of Magnetic Resonance imaging –A signal processing perspective, MetinAkay (Editor), IEEE press, New York, 2000.

BM 122

PHYSIOLOGICAL CONTROL SYSTEMS

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 3

Course Objectives:

- To introduce the students to physiological signal analysis
- To make the students understand the underlying conceptual models of physiological processes
- To make the students analyze simple physiological control systems

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

1. Compare physiological and general engineering control systems
2. Apply time and frequency domain analysis techniques on physiological control systems
3. Analyze the stability and optimization of physiological control systems
4. Model the electrophysiological concepts of neuromuscular system
5. Model the cardiovascular and other physiological systems

UNIT-I

Physiological Systems with feedback, modeling of physiological systems, model based noise reduction and feature extraction. Physiological control systems analysis. Differences between engineering and physiological control systems, Mathematical modeling, linear models of physiological systems, distributed parameter and lumped parameter models

UNIT-II

Static analysis of physiological systems, Determination of steady state operating point, Steady state analysis, Regulation of cardiac output, Chemical regulation of ventilation. Time domain analysis of linear control systems. Transient response analysis- dynamics of neuromuscular reflex motion. Frequency domain analysis of linear control systems, frequency response of circulatory control and glucose insulin regulation.

UNIT-III

Relative stability, Stability analysis of pupilary light reflex, model of Cheyne-Stokes breathing. Identification of physiological control systems, parametric estimation, identification of closed loop system, optimization of physiological control, single parametric optimization, constrained optimization, and adaptive control of physiological variables.

UNIT-IV

Modeling the nerve action potential, voltage clamp experiment and its interpretation, model for the strength duration curve, modeling skeletal muscle contraction, cross bridge theory of muscle contraction, linear model of muscle contraction, applications of skeletal muscle contraction, modeling myoelectric activity

UNIT-V

System identification in physiology, modeling of sensory receptors and pupil control system. Modeling cardiovascular system, Modeling blood flow, systemic blood flow and coronary circulation. Behavior of the immune system, linearized model of immune response to disease.

Suggested Reading:

1. Michael C.K. Khoo, *Physiological Control Systems-Analysi,s Simulation and Estimation*, IEEE Press Series in Biomedical Engineering, 2000.
2. Suresh R. Devasahayam, *Signals and Systems in Biomedical Engineering-Signal Processing and Physiological Systems Modeling*, Kluwer Academic/Plenum Publishers, 2000.

BM 123

ELECTROMAGNETIC BIO-INTERACTION

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 3

Course Objectives:

- To introduce the students to the biological effects of Electromagnetic radiation
- To make the students understand the interaction mechanisms of EM radiation with biological substances
- To make the students gain basic knowledge of biological effects of Electromagnetic radiation

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

1. Understand the coupling of human body to EM radiation
2. Discuss the interaction mechanisms of EM radiation with human body
3. Describe the instrumentation used in bioelectromagnetics
4. Assess the biological effects and health implications of EM radiation
5. Describe the cellular and sub cellular effects of EM radiation

UNIT-I

Electromagnetic Spectrum, Exposure and absorption parameters, International guidelines, Currents induced in standing human being for vertically polarized plane wave exposure conditions, contacts hazards in VLF to HF band, thermal implications of high SARs. Coupling of human body to RF magnetic fields, Radio Frequency protection guide (RFPG).

UNIT-II

EM bio engineering: Extremely LF, EM fields, dielectric heating, broadcast radiation, MW ovens, EM fields in medicine, electrical properties of biological substances, Interaction mechanisms. Application of the finite-differences time domain and the SINC-function Fast Fourier Transform method of moments.

UNIT-III

Role of Experimental Techniques and Instrumentation in bioelectromagnetics: Irradiation systems for bioeffects experiments, Far-field exposure techniques, Instrumentation, Measurements of internal fields and radiofrequency absorption in biological systems, Instruments for measuring Specific Absorption Rates.

UNIT-IV

EM energy absorption in human and animals: Measurement techniques, Free space irradiation conditions, Ground effects, SAR exposure assessment and safety guidelines.
Biological effects and Health implications: Effects due to extremely LF and 60 Hz fields.

UNIT-V

Biological effects of millimeter wave radiation: Experimental approaches, frequency specific effects, genetic systems, cellular and sub cellular effects. Electromagnetic methods for medical applications.

Suggested Reading:

1. Gandhi Om.P, Biological effects and medical applications of Electromagnetic Energy Biophysics and Bioengineering series, Prentice Hall Advanced reference series, Englewood cliffs, New Jersey,1990
2. Franceschetti G, Om P Gandhi and MatiniGrandlfo, Electromagnetic biointeraction, Plenum Press, New York,1989.

BM 124

ENTERPRISE MANAGEMENT

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To provide students with a background of Indian industry and factors that has major influence on business.
- To promote first generation entrepreneurs.
- To encourage patent applications.

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

1. Appraise the business environment and its scope
2. Understand the concepts, functions and growth of entrepreneurs
3. Identify elements of project management to plan, control and organize the resources
4. Acquire knowledge on time management
5. Learn formalities and documentation required for registration of patents.

UNIT-I

Indian Industrial Environment-Competence, opportunities and Challenges, entrepreneurship and economic growth, Small Scale Industry in India, Objectives, Linkage among small, Medium and heavy Industries, Types and forms of enterprises.

UNIT-II

Identification and Characteristics of entrepreneurs, Emergence of First generation entrepreneurs, environmental influence and women Entrepreneurs, Conception and evaluation of ideas and their sources. Choice of Technology-Collaborative interaction for Technology development.

UNIT-III

Project formulation, analysis of market demand, demand - supply gap, Financial and Profitability analysis and technical analysis, project financing in India. Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management, Assessment of tax burden.

UNIT-IV

Behavioral aspects of entrepreneurs: Personality - determinants, attributes and models, leadership concepts and models, values and attitudes, Motivation aspects, change behavior, Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix

UNIT-V

Property Rights: intellectual property rights- Nature of I.P- Protection of I.P rights- Kinds of Intellectual Property Rights- International conventions of Intellectual property rights- Patent treaty 1979, GATT 1994, TRIPS & TRIMS- International organization for protection of IPR- WTO, WIPO, UNESCO.

Patents: Meaning of patent- commercial significance- obtaining of patent- patentable subject matter- rights and obligations of patentee- specification- registration of patents – compulsory licensing and licenses of rights- Revocation.

Suggested Reading:

1. Vasant Desai, *Dynamics of Entrepreneurial development and Management*, Himalaya Publishing house, 1997.
2. Prasanna Chandra, *Project planning, analysis, selection, implementation and review*, Tata Mc-Graw Hill, 1995.
3. Sudha G.S., *Organizational behaviour*, National publishing house, 1996.
4. Cornish W.R., *Intellectual property; Patents, Copyright, Trademarks and Allied Rights*, Sweet & Maxwell Publications.

AC 035

STRESS MANAGEMENT BY YOGA

Instruction: 2 periods per week Duration of SEE: 3 hours
CIE: 30 marks SEE: 70 marks
Credits: 0

Course Objectives:

- Creating awareness about different types of stress and the role of yoga in the management of stress.
- Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
- Prevention of stress related health problems by yoga practice.

Course Outcomes: At the end of this course, students will be able to**:**

1. Understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas and pranayama.
5. Improve work performance and efficiency.

UNIT – I

Introduction*:* Definition of **Stress** – Types of stress: Acute an chronic - Stressors – Definition of **Yoga** from various sources – Types of yoga – Karma yoga, Gnana yoga, Bhakti yoga and Raja yoga – Concept of Bhagavad Geeta - Yoga versus exercise –Basics of Physiology and Psycholoy – Brain and its parts – CNS and PNS – HPA axis – Sympethetic and Para sympethetic nervous systems – Fight and Flight mechanism - Relationship between stress and yoga.

UNIT – II

Ashtanga Yoga: Do`s and Don'ts in life: (i) **Yam** - Ahinsa, satya, astheya, bramhacharya and aparigraha (ii) **Niyam**-Shaucha, santosh, tapa, swadhyay, ishwarpranidhan (iii) **Asana** (iv) **Pranayama (**v) **Prathyahara (**vi) **Dharana** (vii) **Dhyana (**viii) **Samadhi** – Illustrations of eight steps of Ashtanga yoga.

UNIT – III

Asana and Stress: Definition of Asana from Pathanjali – Origin of various names of asanas - Variousyog poses and their benefits for mind & body – Sequence of performing asanas: Standing, sitting, lying down on stomach, lying down on back and inverted postures – Activation of Annamayakosha – Effect on various chakras, systems and glands thereby controlling the stress levels through the practice of asanas.

UNIT – IV

Pranayama and Stress: Definition of pranayama from Shankaracharya - Regularization of breathing techniques and its effects - Types of pranayama – Heat generating and cold generating techniques – Pranayama versus chakras and systems – Breathing techniques versus seasons - Anger and breathing rate – Activation of pranamayakosha – Pranayama as the bridge between mind and body – Stress control through pranayama.

UNIT – V

Dhyana and Stress*:* Distinction between Dhyana and Dharana– Preparation for Dhyana through prathyahara and dharana – Activation of Vignanamayakosha – Types of mind: conscious, superconscious and subconscious – Activation of manomayakosha through Dhyana – Silencing the mind thereby controlling the stress levels

References:

1. ‘Yogic Asanas for Group Tarining-Part-I” : Janardan Swami YogabhyasiMandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata
3. Light on yoga by BKS Iyengar
4. “The search for happiness and bliss” by Swami Sarvapriyananda on you tube – https://youtu.be/xfywJTPkw7Y
5. “Mastering the mind” by SwaminiVimalananda on you tube - https://youtu.be/EXniWH9DMF8

AC 036

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Instruction: 2 periods per week
CIE: 30 marks
Credits: 0

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes: At the end of this course, students will be able to**:**

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

UNIT-I

Neetisatakam-Holistic development of personality

- Verses- 19, 20, 21, 22 (wisdom)
- Verses- 29, 31, 32 (pride & heroism)
- Verses- 26, 28, 63, 65 (virtue)
- Verses- 52, 53, 59 (dont's)
- Verses- 71, 73, 75, 78 (do's)

UNIT-II

- Approach to day to day work and duties.
- Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5, 13, 17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT-III

- Statements of basic knowledge.
- Shrimad BhagwadGeeta : Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16, 17, 18
- Personality of Role model. Shrimad Bhagwad Geeta : Chapter2-Verses 17, Chapter 3-Verses 36, 37, 42,
- Chapter 4-Verses 18, 38, 39
- Chapter18 – Verses 37, 38, 63

Suggested Reading:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata

2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSamskritSansthanam, New Delhi.

AC 037

CONSTITUTION OF INDIA

Instruction: 2 periods per week
CIE: 30 marks
Credits: 0

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

Students will be able to:

- 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 of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes:

1. Students will be able to:
2. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
3. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
4. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
5. Discuss the passage of the Hindu Code Bill of 1956.

UNIT-I

• **History of Making of the Indian Constitution:**
History
Drafting Committee, (Composition & Working)

UNIT-II

• Philosophy of the Indian Constitution:
Preamble
Salient Features

UNIT-III

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

UNIT-IV

- 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-V

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

UNIT-VI

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

Suggested Reading:

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.

AC 038

PEDAGOGY STUDIES

Instruction: 2 periods per week
CIE: 30 marks
Credits: 00

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-I

- Introduction and Methodology:
- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions.
- Overview of methodology and Searching.

UNIT-II

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

UNIT-III

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV

- Professional development: alignment with classroom practices and follow-up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

UNIT-V

Research gaps and future directions

- Research design
- Contexts
- Pedagogy
- Teacher education

- Curriculum and assessment
- Dissemination and research impact.

Suggested Reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

BM070

MINI PROJECT

Instruction	06 Periods per week
End Semester Evaluation	50 Marks
Credits	03

Course Outcomes: At the end of the course, the student will be able to:

1. Identify engineering problems reviewing available literature.
2. Understand of contemporary / emerging technology for various processes and systems.
3. Share knowledge effectively in oral and written form and formulate documents

GUIDELINES:

The students are required to search / gather the material / information on a specific topic comprehend it and present / discuss in the class. Students can take up small problems in the field of design engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution. Continuous assessment of Mini Project at Mid Semester and End Semester will be monitored by the departmental committee.

BM 153

BIOMEDICAL SIGNAL & IMAGE PROCESSING LAB

Instruction	3 Periods per week
CIE	50 Marks
Credits	1.5

Course Objectives:

- To make the students develop programs on process of medical signals.
- To make the students develop programs on process of medical images.

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

1. Design and apply the filters for the pre-processing of Bio signals and medical images.
2. Develop programs for the processing and compression of medical signals.
3. Develop programs for basic operations on medical images.

Experiments on Signal Processing:

1. Use of DSP processors-6X and 2X series for
   (i) Generation of basic signals.
   (ii) Linear and circular convolution
   (iii) Realization of FIR and IIR filters
   (iv) Finding DFT and IDFT of given sequence
   (v) Plotting the power spectral density
2. Computation of convolution and correlation sequences.
3. Signal averaging improvement in the SNR Using coherent and incoherent averaging.
4. Exponential averaging.
5. Data polishing: mean and trend removal
6. Design of IIR and FIR Filter
7. PSD Estimation
8. AR Modeling for Predictive Filters
9. LMS Based Algorithm for Adaptive Noise Canceling
10. Data Compression Techniques: AZTEC, TP, CORTES, KL Transform
11. Template matching algorithm for QRS detection
12. Classification of EEG waves.

Experiments on Image Processing:

1. Reading and displaying JPEG and BMP images.
2. Negative of an image.
3. Contrast Stretching
4. Logarithmic Transform.
5. Power-law Transform.
6. Transpose of an image.
7. Filtering in spatial domain
   a. High pass filter.
   b. Low pass filter
   c. Laplacian filter.
8. Filtering in frequency domain
   a. Low pass filter
   b. High pass filter
   c. Butterworth low-pass & high-pass filters.
   d. Gaussian low pass& high pass filter
9. determine the image after applying the threshold
10. Highlight a specific range of gray levels in a given image.
11. Enhance the given image by Histogram processing & Histogram Equalization.
12. Edge detection operators

BM 154

VIRTUAL INSTRUMENTATION LAB

Instruction	3 Periods per week
CIE	50 Marks
Credits	1.5

Course Objectives:

- To make the students design and test systems for medical applications
- To make the students develop programs for filtering noisy medical signals

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

1. Design and test systems for biopotential signals
2. Design and test a3 op-amp instrumentation amplifier
3. Design filters for biopotential signals

Design/Fabrication and testing of following list using Labview:

1) ECG system
2) EEG system
3) EMG system
4) GSR system
5) 3 Op-Amp Instrumentation Amplifier
6) Filters:
   i. Notch Filter
   ii. Low pass Filter
   iii. High Pass Filter
   iv. Filters in feedback loop

BM 125

MEDICAL PRODUCT DESIGN

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To make students understand the basic design rules in designing the Medical Products.
- To make students learn the Medical device directives.
- To make students learn the medical device standards and regulations.

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

1. Learn the classification and Overview of Medical devices.
2. Know the software and hardware design of products.
3. Knowledge of Testing and data analysis of medical devices
4. Knowledge of Good Manufacturing process and regulations.
5. Knowledge of ISO standards and regulations.

UNIT-I

Medical devices. Overview of product .Product definition process. Quality function deployment process. Materials-Biocompatibility, International regulatory efforts. Device category and choice of test programs. Biological control tests. Test for biological evaluation.

UNIT-II

Specifying and designing the product. Engineering requirements-design specification, risk management, intellectual property-patents, human factors, Hardware design-component selection, design of experiments, software design- object oriented design, software coding.

UNIT-III

Testing and data analysis. Basis and types of testing, hardware verification and validation-standard tests , software verification and validation, reliability evaluation, analysis of test results-failure rate, Mean Time Between Failures (MTBF).

UNIT-IV

Manufacturing and Maintenance process. Good manufacturing process (GMP), the GMP Regulation, Design for manufacturability, manufacturing process, Quality systems regulation, configuration management, Quality system audit, analysis of field data.

UNIT-V

Medical device regulations and standards. Food and Drug Administration, Medical device directives ISO 9001 series of standards, Domestic standards, International standards.

Suggested Reading:

1. Richard C.Fries, *Reliable design of medical devices*, Marcel Dekker Inc., 1997.
2. Richard C.Fries, *Handbook of medical device design*, Marcel Dekker Inc., 2001.

BM 126

LASERS IN MEDICINE

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To make students know the basic optical laws and fiber optic fundamentals.
- To expose students to laser fundamentals and fiber optic applications in medicine
- To make students clearly understand laser applications in medicine and laser safety fundamentals

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

1. Understand the basicoptical laws and properties of fiber optics
2. Implement working principle of lasers for medical applications
3. Analyze the tissue characteristics when light interacts with tissues
4. Provide adequate knowledge about various lasers used in medical applications
5. Appraise the laser safety standards, hazardsand precautions

UNIT I:

Basic optical laws and definitions, optical fiber modes and configuration, single mode fibers, graded index fiber structure, fiber materials, attenuation, signal distortion in optical waveguides, pulse broadening in graded index waveguides.

UNIT-II :

Medical Lasers: Introduction, Laser physics- fundamentals, principles, advances. Medical Laser system-fundamentals, principles.
Reflection and Refraction, Absorption, Scattering, turbid media, Photon Transport Therapy, Measurement of optical Tissue Properties.

UNIT-III:

Photochemical interaction-Photo Dynamic Therapy, Biostimulation
Thermal interaction- Heat Generation, Heat Transport, Heat Effects, laser-induced interstitial thermotherapy
Photo-ablation – Model of photo-ablation, cytotoxicity of UV Radiation
Plasma induced ablation- Model of Plasma induced ablation, Analysis of Plasma parameters,
Photo-disruption- Plasma formation,Shockwave Generation, Cavitation, Jet formation

UNIT-IV:

Lasers In Opthalmology, Dentistry, Gynecology, Urology, Neurosurgery, Angioplasty and Cardiology, Dermatology, Orthopedics, Gastroenterology, orthinolaryngology and Pulmonology.

UNIT-V:

Laser safety-fundamentals. Laser hazards, skin hazards, eye hazards, Associated hazards from high power lasers, laser safety standards and hazard classification, viewing laser radiation, eye protection, laser calculations and measurements.

Suggested Reading:

1. Markolf H. Niemz, laser-tissue interactions fundamentals and applications, Springer
2. Laser and optical fibers in Medicine by Abraham Katzir, Academics Press, 1998.
3. Keiser, Optical Fiber Communication Systems, Mc Graw Hill Ltd., 1983
4. Medical Lasers and their safe use DAVID H Shiney. Stephen and L Trokel, Springer, Springer. verlag publications.

BM 127

TISSUE ENGINEERING

Instruction: 3periods per week
Duration of SEE: 3 hours
CIE: 30 marks
SEE: 70 marks
Credits: 3

Course Objectives:

- To make students understand the tissue development and in vivo synthesis.
- To make students gain basic knowledge on the models and approaches in engineered issues.
- To make students appreciate the applications of tissue Engineering

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

1. Articulate the scientific vocabulary used to communicate information in tissue engineering.
2. Understand the fundamental role of tissue engineering in cells, scaffold and growth factors.
3. Acquire knowledge on stem cells and their importance in tissue regeneration.
4. Memorize the concepts and properties of various biomaterials used in biomedical applications.
5. Apply tissue engineering concepts in clinical studies.

UNIT – I

Growth and Differentiation, Organization of cells into Higher ordered structures, Dynamics of cells-ECM interactions, Matrix molecules and Their ligands, Inductive Phenomena, Cell Determination and Differentiation, Mechanical and Chemical determination of Tissue Development, Animal Cell Culture, Regulations of cell Behaviors cellular proteins, Growth factors, Tissue Assembly in Micro Gravity, In vivo Synthesis of Tissues and Organs.

UNIT – II

Organotypic and Histiotypic Models of Engineered Tissues, Quantitative aspects of Tissue Engineering: Basic Issues in Kinetics, Transport and Mechanics, Patterning of cells and their environment, Cell Interactions with Polymers, Matrix Effects, Polymer Scaffold Processing, Biodegradable Polymers.

UNIT – III

Approaches to transplanting Engineered cells and Tissues, Cryopreservation, Immuno-modulation, Immuno-isolation, Engineering challenges in immuno-isolation, Fetal tissue Engineering, Pluri potent stem cells, Gene Therapy.

UNIT – IV

Applications: Breast Reconstruction, Cardiovascular Systems-Blood Vessels, Small diameter Vascular Grafts, Cardiac Prosthesis. Cornea. Endocrinology and Metabolism-Bioartificial Pancreas, Parathyroid.

UNIT – V

Musculoskeletal System-Structural Tissue Engineering, Bone Regeneration through Cellular Engineering. Gastrointestinal System –Alimentary tract, Liver, Hepato Assist liver support system, Linage Biology and liver. Hematopoitic Systems-Red Blood Cell Substitutes, Lymphoid Cells, Hemapoietic Stem Cells. Kidney and Genitourinary system-Renal Replacement Devices, Genitourinary System.

Suggested Reading :

1. Robert P. Lanza, Robert P. Langer, Joseph P. Vacanti, *Principles of Tissue Engineering*, Academic Press, 2nd ed. 2000.
2. FarshidGuilak, David L. Butler, Steven A. Goidstein, *Functional Tissue Engineering*, Springer Verlag, 2004.
3. Frederick H. Silver, *Biomaterials, and Medical Devices & Tissue Engineering: An integrated approach*, Chapman & Hall, London, 1994.

BM 128

MEDICAL OPTICS

Instruction: 3periods per week
Duration of SEE: 3 hours
CIE: 30 marks
SEE: 70 marks
Credits: 3

Course Objectives:

- To familiarize students with optical fibers and their properties.
- To offer students with clear understanding of photonic instrumentation
- To make students understand the properties and working of optical sources and detectors used in light transmission through optical cables.

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

1. Understand the fundamental working principles of optical fibers and their types.
2. Analyze the tissue characteristics when the light interacts with tissues.
3. Design photonic instrumentation for medical applications
4. Provide adequate knowledge about various optical sources used for diagnostic applications.
5. State various optical therapy techniques used in medicine

UNIT I Introduction to Optical Fibers

Basic optical laws and definitions, optical fiber modes and configuration, single mode fibers, graded index fiber structure, fiber materials, attenuation, signal distortion in optical waveguides, pulse broadening in graded index waveguides.

UNIT II Optical properties of tissues

Tissue properties – refractive indices, scattering and absorption properties, light transport inside the tissue, light interactions with a strongly scattering tissue – continuous wave light, short light pulses, diffused photon density waves, Temperature rise and tissue damage – optothermal and opt acoustic effects. Fluorescence speckles.

UNIT III Instrumentation in Photonics

Instrumentation for absorption, scattering and emission measurement, excitation light sources – high pressure arc lamp, solid state LEDs, LASERs, optical filters, polarizer's, solid state detectors, time resolved and phase resolved detectors

UNIT IV Biophotonic Diagnostics

Near IR spectroscopy for biological glucose analysis, flow cytometry – basic operation, optical response – applications – optical biosensors – principles, bio-recognition, optical transduction – Bio-imaging – cellular, tissue imaging and in vivo imaging. Introduction to Optical Coherence Tomography

UNIT V Biophotonic Therapy

Photodynamic therapy – basic principle, photo sensitizers, mechanism of photodynamic action, applications – Laser tissue welding, lasers in dermatology, neurosurgery, ophthalmology, urology.

Suggested Reading

1. Keiser, Optical *Fiber Communication Systems*, Mc Graw Hill Ltd., 1983
2. Ed., Tuan Volume Dinh, "Biomedical Photonics Handbook", CRC Press, 2003.
3. Leon Goldman, "The Biomedical Laser Technology and Clinical Applications", Springer Verlag, 1981.
4. Leon Goldman and R. James Rockwell, "Lasers in Medicine", Gordan& Breach, Science Publishers Inc, 1971
5. Koebmer K R, "Lasers in Medicine", John Wiley & Sons, 1980
6. Paras N Prasad, "Introduction to Biomedical Photonics", John Wiley. 2003

OE 941

BUSINESS ANALYTICS

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- Understanding the basic concepts of business analytics and applications
- Study various business analytics methods including predictive, prescriptive and prescriptive analytics
- Prepare the students to model business data using various data mining, decision making methods

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

1. To understand the basic concepts of business analytics
2. Identify the application of business analytics and use tools to analyze business data
3. Become familiar with various metrics, measures used in business analytics
4. Illustrate various descriptive, predictive and prescriptive methods and techniques
5. Model the business data using various business analytical methods and techniques

UNIT-I

Introduction to Business Analytics: Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DD decision making and future.

UNIT-II

Descriptive Analytics: Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile and quadrille, measures of variation, measures of shape-skewness, data visualization

UNIT-III

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient

UNIT-IV

Decision Trees: CHAID, Classification and Regression tree, splitting criteria, Ensemble and method and random forest. **Clustering**: Distance and similarity measures used in clustering, Clustering algorithms, K-Means and Hierarchical algorithms, **Prescriptive Analytics** - Linear Programming (LP) and LP model building,

UNIT-V

Six Sigma: Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process, cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score, DMAIC methodology, Six Sigma toolbox.

Suggested Reading:

1. U Dinesh Kumar, “Data Analytics”, Wiley Publications, 1st Edition, 2017.

2. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, “Business analytics Principles, Concepts, and Applications with SAS”, Associate Publishers, 2015.

3. S. Christian Albright, Wayne L. Winston, “Business Analytics - Data Analysis and Decision Making”, 5th Edition, Cengage, 2015.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18-mg11/preview

2. https://nptel.ac.in/courses/110105089/

OE 942

INDUSTRIAL SAFETY

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

UNIT-I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT-II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT-III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, (i) Screw down grease cup, (ii) Pressure grease gun, (iii) Splash lubrication, (iv) Gravity lubrication, (v) Wick feed lubrication (vi) Side feed lubrication, (vii) Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, (i) Any one machine tool, (ii) Pump (iii) Air compressor, (iv) Internal combustion engine, (v) Boiler, (vi) Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: (i) Machine tools, (ii) Pumps, (iii) Air compressors, (iv) Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Suggested Reading:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OE 943

OPERATIONS RESEARCH

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

Course Outcomes: At the end of the course, the student should be able to

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

UNIT-I

Optimization Techniques, Model Formulation, models, General LR Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

UNIT-II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

UNIT-III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

UNIT- I V

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT -V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

Suggested Reading:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

OE 944

COST MANAGEMENT OF ENGINEERING PROJECTS

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 3

Introduction and Overview of the Strategic Cost Management Process

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Suggested Reading:

2. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
3. Charles T. Horngren and George Foster, Advanced Management Accounting
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
5. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
6. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

OE945

COMPOSITE MATERIALS

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To understand the fundamentals of composite materials and the role of matrix and reinforcement.
- To know the principles of manufacturing composite
- To understand the strength and failure criteria of lamina and laminate.

Course Outcomes: After completion of the course student will be able to:

1. Define a composite, identify the matrix and reinforcement and highlighting the features and application of different composite materials.
2. Classify composites, illustrate the mechanical behaviour of composites and predict properties using micromechanics principles.
3. Illustrate the manufacturing of metal matrix composites and outline the properties and applications.
4. Illustrate the manufacturing of Polymer matrix composites and outline the properties and applications.
5. Apply various failure criteria to assess the strength of lamina and laminates.

UNIT-I Introduction:
Definition- Classification and characteristics of composite materials. Advantages and applications of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, distribution, volume fraction) on overall composite performance.

UNIT-II Reinforcements:
Preparation-layup, curing, properties and applications of glass fibers, carbon fibers and Boron fibers. Properties and applications of whiskers, particulate reinforcements. Mechanical Behaviour of composites: Rule of Mixtures, Inverse rule of mixtures. Isostrain and Isostress condition.

UNIT- III Manufacturing of Metal Matrix Composites:
Casting-Solid State diffusion technique, Cladding-Hot Isostatic pressing, Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration-Liquid phase sintering, Manufacturing of Carbon-Carbon composites: Knitting, Braiding, Weaving, Properties and applications..

UNIT-IV Manufacturing of Polymer Matrix Composites:
Preparation of Moulding compounds and prepregs-hand layup method-Autoclave method-Filament winding method-Compression moulding-Reaction injection moulding, Properties and applications.

UNIT-V Strength:
Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydrothermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentration.

Suggested Reading:

1. Material Science and Technology- Vol 13- Composites by R.W. Cahn-VCH, West Germany.
2. Materials Science and Engineering, An Introduction. WD Callister, Jr., Adapted byR. Balasubramaniam, John Wiley &Sons, NY, Indian edition, 2007.
3. Composite Materials- K. K. Chwala.
4. Composite Materials Science and Applications-Deborah D.L. Chung.
5. Composite Materials Design and Applications-Danial Gay, Suong V. Hoa and Stwphen W. Tsai.

OE946

WASTE TO ENERGY

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To know the various forms of waste
- To understand the processes of Biomass Pyrolysis.
- To learn the technique of Biomass Combustion.

Course Outcomes:

- Understand the concept of conservation of waste
- Identify the different forms of wastage
- Chose the best way for conservation to produce energy from waste
- Explore the ways and means of combustion of biomass
- Develop a healthy environment for the mankind

UNIT-I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT-II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal –Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraftgasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Suggested Reading:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical HandBook - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

OE947EC

INTERNET OF THINGS
(Open Elective)

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 3

Course Objectives:
- To understand the concepts of Internet of Things and able to build IoT applications
- To learn the programming and use of Arduino and Raspberry Pi boards.
- To know about data handling and analytics in SDN.

Course Outcomes:
After Completion of the course Student will be able to:
1. Known basic protocols in sensor networks.
2. Program and configure Arduino boards for various designs.
3. Python programming and interfacing for Raspberry Pi.
4. Design IoT applications in different domains.

UNIT – I
Introduction to Internet of Things, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks.

UNIT – II
Machine-to-Machine Communications, Difference between IoT and M2M, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino,

UNIT – III
Introduction to Python programming, Introduction to Raspberry Pi, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi

UNIT - IV
Implementation of IoT with Raspberry Pi, Introduction to Software defined Network (SDN), SDN for IoT, Data Handling and Analytics,

UNIT - V
Cloud Computing, Sensor-Cloud, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring

Suggested Readings:
1. "The Internet 'of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. “Make sensors”: Terokarvinen, kemo, karvinen and villeyvaltokari, 1st edition, maker media,2014. 3. "Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti
3. Vijay Madisetti, ArshdeepBahga, “Internet of Things: A Hands-On Approach”
4. WaltenegusDargie,ChristianPoellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"
5. Beginning Sensor networks with Arduino and Raspberry Pi – Charles Bell, Apress, 2013

OE948CS

CYBER SECURITY

(Open Elective)

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives

- Learn the various threats in networks and security concepts.
- Apply authentication applications in different networks.
- Understand security services for email.
- Awareness of firewall and IT laws and policies

Course Outcomes:

After completion of this course, the students shall be able to:

1. Understand the various network threats.
2. Analyze the forensic tools for evidence collection.
3. Apply the firewalls for threat analysis.

UNIT-I

Ethical hacking, Attack Vectors, Cyberspace and Criminal Behaviour, Clarification of Terms, Traditional Problems associated with Computer Crimes, Realms of Cyber world, brief history of the internet, contaminants and destruction of data, unauthorized access, computer intrusions, white-collar crimes, viruses and malicious code, virus attacks, pornography, software piracy, mail bombs, exploitation, stalking and obscenity in internet, Cyber psychology, Social Engineering.

UNIT-II

Introduction to Digital forensics, Forensic software and handling, forensic hardware and handling, analysis and advanced tools, forensic technology and practices, Biometrics: face, iris and fingerprint recognition, Audio-video evidence collection, Preservation and Forensic Analysis.

UNIT-III

Investigation Tools, e-discovery, EDRM Models, digital evidence collection and preservation, email investigation, email tracking, IP tracking, email recovery, searc and seizure of computer systems, password cracking.

UNIT-IV

Forensic Analysis of OS artifact, Internet Artifacts, File System Artifacts, Registry Artifacts, Application Artifacts, Report Writing, Mobile Forensic- identification, collection and preservation of mobile evidences, social media analysis, data retrival, Email analysis from mobile phones.

UNIT-V

Ethics, Policies and IT Act Basics of Law and Technology, Introduction to Indian Laws, Scope and Jurisprudence, Digital Signatures, E Commerce-an Introduction, possible crime scenarios, law coverage, data interchange, mobile communication development, smart card and expert systems Indian Laws, Information Technology Act 2000, Indian Evidence Act, India Technology Amendment Act 2008, Indian Penal Code , Computer Security Act 1987, National Information Infrastructure Protection Act 1996, Fraud Act 1997, Children Online Protection Act 1998, Computer Fraud and Abuse Act 2001, Intellectual Property, IP Theft, Copyright, Trademark, Privacy and Censorship, Introduction to Cyber Ethics, rights over intellectual property, Corporate IT Policy Formulations, Compliance Auditing.

Suggested Readings

1. Charles P. Fleeger, "*Security in Computing*", Prentice Hall, New Delhi, 2009.
2. BehrouzA.Forouzan, "*Cryptography & Network Security*", Tata McGraw Hill, India, New Delhi, 2009.
3. William Stallings, "*Cryptography and Network Security*", Prentice Hall, New Delhi, 2006.
4. Chalie Kaufman, Radia Perlman, Mike Speciner, "*Network Security: Private Communication in a Public Network*", Pearson Education, New Delhi, 2004.
5. Neal Krawetz, "*Introduction to Network Security*", Thomson Learning, Boston, 2007.
6. Bruce Schneier, "*Applied Cryptography*", John Wiley & Sons, New York, 2004.

BM 181

MAJOR PROJECT PHASE-I

Instruction	20 Periods per week
End Semester Evaluation	70 Marks
Mid Semester Evaluation	30 Marks
Credits	10

Course Outcomes: At the end of the course, the student will be able to:

1. Synthesize knowledge and skills previously gained and apply them to new technical problem.
2. Select from different methodologies, methods and analyses to produce a suitable research design, and justify their design.
3. Present the findings of their technical solution in a written report.
4. Presenting the work in International/ National conference or reputed journals.
5. Develop oral and written communication skills to present and defend their work in front of technically qualified audience

GUIDELINES:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Biomedical Instrumentation, Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Robotics and Control Systems, Signal and Image Processing and Analysis and any other related domain. In case of industry sponsored projects, the relevant application notes, product catalogues should be referred and reported. The student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

Evaluation for stage-I is based on mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution. Continuous assessment of Project stage – I at Mid Semester and End Semester will be monitored by the departmental committee.

A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, record of continuous progress. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

BM 182

MAJOR PROJECT PHASE-II

Instruction	32 Periods per week
End Semester Evaluation	200 Marks
Credits	16

Course Outcomes: At the end of the course, the student will be able to:

1. Use different experimental techniques.
2. Use different software/ computational/analytical tools.
3. Design and develop an experimental set up/ equipment/test
4. Conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
5. Either work in a research environment or in an industrial environment.
6. Present and convince their topic of study to the engineering community.

GUIDELINES:

Project stage – II will be extension of the work on the topic identified in Project stage – I. Student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study.

A dissertation should be presented in standard format as provided by the department. The candidate has to be in regular contact with his guide. Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be pre-submission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.