With effect from the academic year 2021-2022

DEPARTMENT OF BIOMEDICAL ENGINEERING

Scheme of Instruction

and

Syllabi of

B.E. VII & VIII Semesters

2021-2022

AICTE Model Curriculum

UNIVERSITY COLLEGE OF ENGINEERING

(AUTONOMOUS)

OSMANIA UNIVERSITY

HYDERABAD – 500 007 TELANGANA

With effect from the academic year 2021-2022

SCHEME OF INSTRUCTION
B.E. (BIOMEDICAL ENGINEERING) VII - SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction			hr/ week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
1	PC 701 BM	Biomedical Signal Processing	3	0	0	3	30	70	3
2	PC 702 BM	Medical Image Processing	3	0	0	3	30	70	3
3	**Professional Elective IV**		3	0	0	3	30	70	3
	PE 741 BM	Nanotechnology for Medical Applications							
	PE 742 BM	Cell & Tissue Engineering							
4	**Professional Elective V**		3	0	0	3	30	70	3
	PE 751BM	Fiber Optics & Lasers in Medicine							
	PE 752 BM	Rehabilitation Engineering							
5	HS 701 BM	Hospital Administration Management	3	0	0	3	30	70	3
6	OE	**Open Elective II**	3	0	0	3	30	70	3
Practicals									
7	PC 751 BM	Biomedical Signal Processing Lab	0	0	2	2	25	50	1
8	PC 752 BM	Medical Image Processing & Modeling Lab	0	0	2	2	25	50	1
9	PW 751 BM	Major Project Phase - I	0	0	4	4	50	-	2
10	PW 961 BM	Summer Internship	6 Weeks				50	-	-
Total			**18**	**0**	**8**	**26**	**330**	**520**	**22**

L-Lectures; T-Tutorials; P-Practicals; CIE-Continuous Internal Evaluation; SIE-Semester End Evaluation

Open Elective-II

S.No.	Course Code	Course Title
1.	OE701BM	Micro Electro-Mechanical Systems
2.	OE702CE	Green Building Technology
3.	OE703CS	Information Security
4.	OE704CS	Data Base Management Systems
5.	OE705EC	Embedded Systems
6.	OE706EC	Very log HDL
7.	OE707EC	Satellite Communication and Applications
8.	OE708EE	Optimization Techniques
9.	OE709EE	Non-Conventional Energy Sources
10.	OE710ME	Industrial Robotics
11.	OE711ME	Startup Entrepreneurship
12.	OE712ME	Nano Technology

PC701 BM

BIOMEDICAL SIGNAL PROCESSING

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

Course Objectives:

- Understand the need for adaptive filters
- Appreciate the signal processing techniques used for ECG and EEG
- Comprehend the concepts of wavelet and their application in medicine
- Understand the signal processing steps involved in Brain-Computer Interface

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

1. Identify different types of noises and filters used in biomedical signal processing
2. Process the ECG signal and analyze it
3. Implement signal processing on EEG signal
4. Select and manage appropriate choices of wavelet for signal processing`
5. Extract and realize the features involved in Brain computer interface

UNIT I

Filter design for Biosignal processing:
Butterworth and Chebyshev approximations. IIR digital filter design techniques. Impulse invariant techniques. Bilinear transform techniques. Digital Butterworth filters. Comparison of FIR and IIR filters. Frequency transformations.FIR Digital Design Techniques. Properties of FIR Digital filters. Design of FIR filters using windows. Realization diagrams of IIR and FIR filters, Finite word length effects.

UNIT II

Cardiological Signal Processing: preprocessing of ECG signal, QRS detection methods-Differentiation-based and template-based. Rhythm analysis and Arrhythmia detection algorithms. Automated ECG analysis. Data compression techniques: Turning Point algorithm, AZTEC, CORTES, and the KL transform. Adaptive filters, Weiner filter principles, LMS & RLS, medical Applications of Adaptive Noise Cancellation.

UNIT III

Neurological signal processing: Stochastic process. Linear prediction. Yule-Walker equations. Auto Regressive Modeling of EEG signal. Detection of EEG Rhythms, Template matching for EEG spike-and-wave detection, Detection of EEG spike-and-wave complexes, Coherence analysis of EEG channels, Adaptive segmentation of EEG signals. Sleep stage analysis using Markov model. Analysis of evoked potential using Prony's method.

UNIT IV

Wavelets in Medicine: Need for wavelets, Types of wavelets, Selection of a wavelet for an application, Decomposition and reconstruction of signals using wavelets, Denoising using wavelets, Typical medical applications.

UNIT V

Brain-Computer Interface: Brain signals for BCIs, Generic setup for a BCI, Feature extraction and Feature translation involved in BCIs. Typical medical applications.

Suggested Reading :

1. Rangaraj M. Rangayyan,*"Biomedical Signal Analysis: A Case-Study Approach"*, John Wiley & Sons, 2005.
2. Willis J.Tompkins, "*Biomedical Digital Signal Processing"*, Prentice-Hall of India Pvt. Ltd.,2012.
3. Monson H.Hayes, "*Statistical Digital Signal Processing and Modeling"*, Wiley-India, 2009.
4. Jonathan Wolpaw and Elizabeth Winter Wolpaw, *"Brain-Computer Interfaces: Principles and Practice"*, Oxford University Press, 2012.
5. Stephane Mallat, "*Wavelet Tour of Signal Processing*: *The Sparse Way"*, 3rd ed. Academic Press, 2008.

PC702 BM

MEDICAL IMAGE PROCESSING

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

Course Objectives:

- To understand various image processing methodologies and enhancement techniques on images
- To know about the noise models and filtering methods.
- To analyze the images by applying segmentation methods.
- Gaining fundamental idea on representation, description and recognition of medical images.

Course Outcomes: The student will be able to:

1. Have the basic knowledge of image fundamentals necessary for medical image processing
2. Familiarize with the image enhancement techniques
3. Demonstrate restoration procedures on images.
4. Illustrate image segmentation techniques on the images and analyze them.
5. Exemplify image representation and recognition methods.

UNIT-I: FUNDAMENTALS

Digital image, Elements of digital geometry, Components of DIP, Visual detail.
Visual preliminaries-Brightness adaptation and Contrast, Acuity and contour, Texture and pattern discrimination, Shape detection and recognition, Perception of color. Image formation- Geometric Model and Photometric Model, medical applications

UNIT-II: IMAGE ENHANCEMENT

Spatial Domain Methods –Binary Image, Negative of an Image, Log Transformations, Power law Transformation, contrast enhancement, Histogram equalization, Spatial Domain Filters-Smoothing filters, Sharpening filters.
Frequency Domain Methods- Steps for filtering in the frequency domain, Convolution theorem, Smoothing filters, Sharpening filters, Homomorphic filtering. Medical applications

UNIT-III: IMAGE RESTORATION

A model of the image degradation, noise models, restoration in the presence of noise-spatial filtering, periodic noise reduction by frequency domain filtering, linear & position-invariant degradations, estimating the degradation function, inverse filtering, wiener filtering, constrained least squares filtering, geometric mean filter, medical applications

UNIT-IV: SEGMENTATION

Point detection, line detection, edge detection methods, Histogram based image segmentation, segmentation using split and merge method, region growing method, watershed method, k-means clustering method, self-similar fractal method, comparison of all the methods, medical applications.

UNIT-V: REPRESENTATION, DESCRIPTION AND RECOGNITION

Representation, boundary descriptors, regional descriptors, principal component analysis, relational descriptors. Recognition based on decision-theoretic and structural methods, medical applications.

Suggested Reading :

1. R.C Gonzalez and R.E. Woods, Digital Image Processing, 2nd Ed, Prentice Hall. 2002.
2. Anil K. Jain, Fundamentals of Image Processing, Prentice Hall, Englewood clifs, New Jersey, 1989
3. G.R.Sinha and Bhagavathi Charan Patel, Medical Image Processing concepts and applications,PHI,2014
4. Chanda & Majumdar, Digital image processing and analysis, Second edition PHI, 2013.

PE741 BM

NANOTECHNOLOGY FOR MEDICAL APPLICATIONS

(PROFESSIONAL ELECTIVE IV)

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

Course Objectives:

- To introduce the students to the application of Nanotechnology to medicine
- To familiarize different Nanomaterials and their fabrication
- To introduce the diagnostic and therapeutic applications of Nanomaterials

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

1. Understand characteristics, properties and classification of Nanomaterials.
2. Compare the different types of Nanomaterials.
3. Explain the fabrication techniques of Nanomaterials
4. Recognize the applications of Nanomaterials to diagnostics
5. Apply Nanomaterials to therapeutics.

UNIT-I

Introduction to Nanotechnology: Nano materials- Definition, Structure and bonding, Characteristics and Properties of Nano materials, Classification of Nanodevices based on the characteristics, Nanotechnology in science.

UNIT-II

Nanomaterials: Types of Nanomaterials, Nanoparticles, Quantum dots and their properties, Fullerenes and carbon forms, Carbon Nanoparticles, Carbon Nanotubes, types of carbon Nanotubes, single-walled, multi- walled, torus, Nano bud, properties of carbon Nanotubes.

UNIT-III

Fabrication of Nanomaterials: Fabrication of Nanomaterials by Bottom-up and Top- down approaches, Synthesis of Nanoparticles, Synthesis of carbon Nanotubes by Arc discharge, laser ablation, chemical vapor deposition techniques, Characterization methods of Nanomaterials.

UNIT-IV

Nanomaterials in diagnostics: Molecular imaging, Medical use of Nanomaterials, Quantum Dots and Nanoparticles for cancer imaging, Applications of Nanomaterials in Medical imaging, Neuro-electronic interfaces.

UNIT-V

Nanomaterials in therapeutics: Drug delivery systems, Targeted drug delivery systems, Drug tracking systems, Nanomaterials for drug delivery, Quantum Dots and Nanoparticles for cancer treatment, Nanoparticle mediated gene therapy, Growth of neurons on Nanomaterials, Nanomaterials for brain protection and repair, Nanorobotics for surgery.

Suggested Readings:

1. Alain Nouailhat, *An introduction to Nanoscience and Nanotechnology*, ISBN: 978-0-470-39353-6, Wiley-VCH
2. Gunter Schmid, *Nanotechnology: Volume 1: Principles and Fundamentals* ,ISBN: 978-3-527-31732-5 Wiley-VCH
3. Dieter Vollath,*Nanoparticles - Nanocomposites – Nanomaterials, An Introduction for Beginners*, ISBN: 978-3-527-33460-5, Wiley-VCH
4. CSSR Kumar, J.Hormes, C. Leuschner, *Nanofabrication towards Biomedical, Techniques, Tools, Applications, and Impact*by WILEY-VCH
5. Gabor L. Hornyak, John J. Moore, H.F. Tibbals, Joydeep Dutta, *Fundamentals of Nanotechnology*, ISBN 9781138627413, CRC Press

PE742 BM

CELL AND TISSUE ENGINEERING

(PROFESSIONAL ELECTIVE IV)

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

Course Objectives:

- This course helps to gain deeper knowledge of cell and tissues for variety of approaches used to regenerate the damaged tissue.
- The students will learn about the key concepts of cell biology and tissue organization and the technologies used in tissue engineering.

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

1. Understand the basic concepts of tissue engineering in cells, scaffold and growth factors.
2. Understand the concepts of cell interactions and properties of various biomaterials used in biomedical applications.
3. Acquire knowledge on process of tissue culturing and significance of stem cells in tissue regeneration.
4. Learn about various tools and techniques to analyze the surface characterization and cell structure.
5. Understand the clinical challenges of tissue engineering applications.

UNIT-I

Cell structure and organization: Cell structure and basic functions of various cell organelles. Check points of cell cycle and its applications, cell growth, cell death and differentiation.

UNIT-II

Cell-extracellular matrix interactions: Cell-cell and cell-matrix interactions, cell adhesion molecules, components of the extracellular matrix, cellular junctions, Stem cells.

UNIT-III

Cell and tissue culture for tissue engineering: Cell fractionation. Types of tissue culture, media, culture environment and maintenance of cells in vitro, cryopreservation, cell revival, passage, cell counting.

UNIT-IV

Tools and Techniques of Cell Biology: Histology, staining, fluorescence, confocal microscopy, TEM and SEM, Fluorescent dyes and GFP tagged proteins in visualization.

UNIT-V

Tissue engineering applications and challenges: Types of biomaterials used in hard and soft tissue engineering, Bioreactors, challenges in Bone, Skin, Cornea, Liver tissue engineering applications.

Suggested Reading:

1. Cell and Molecular Biology, Gerald Karp, John Wiley & Sons, Inc.6th Edition ISBN-13 978-0-470-48337-4.
2. The Principles of Tissue engineering (4th edition), by Robert Lanza, Robert Langer, and Joseph P. Vacanti. ISBN: 978-0-12-398358-9.
3. Tissue Engineering. Clemens van Blitterswijk. ISBN: 978-0-12-370869-4.
4. The molecular and cellular biology of wound repair. Clark, Plenum Press.ISBN: 978-1-4615-1795-5.
5. Biomaterials for tissue engineering applications, Burdick, Jason A., Mauck, Robert L. ISBN 978-3-7091-0385-2.

PE751 BM

FIBER OPTICS & LASERS IN MEDICINE

(PROFESSIONAL ELECTIVE V)

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

Course Objectives:

- To offer clear understanding of tissue characteristics when it is exposed to optical energy.
- To know about various optical sources and applications of lasers.
- To expose the students to the Laser fundamentals and fiber optics.

Course Outcomes: Successfully the student will be able to:

1. Use optical sources for Medical LASER instrumentation and measurement.
2. Analyze the optical properties of tissues and light interactions with tissues
3. Understand basic concepts of optical fibers and their properties
4. Applications of Fiber Optics used in medical imaging systems
5. To provide adequate knowledge about Medical applications of Lasers

UNIT-I:

INTRODUCTION: Historical background .Medical Lasers: Introduction, Laser physics- fundamentals, principles, advances. Medical Laser system-fundamentals, principles. Laser safety-fundamentals.
APPLICATION OF LASERS IN DIAGNOSIS &THERAPY: Introduction, Laser assisted diagnosis and therapy fundamentals.

UNIT-II:

LASER-TISSUE INTERACTION: Laser interaction with tissue-principles; laser assisted diagnostic – principles, application of lasers in diagnosis and imaging-advances, laser surgery and therapy – principles-photo thermal & photomechanical mechanism, thermal interaction between laser and tissue-advances.

UNIT-III:

SINGLE OPTICAL FIBER: Introduction, historical background, optical fiber fundamentals. Light transmission in optical fibers-principles, optical properties of optical fibers-advances, fabrication of optical fibers- principles, optical fibers for UV, visible, IR light-principles, power transmission through optical fibers-principles.

UNIT-IV:

OPTICAL FIBER BUNDLES: Introduction, non ordered fiber optic bundles for light guides-fundamental & principles, ordered fiber optic bundles for imaging devices-fundamentals & principles, fiberscope and endoscopes-fundamentals fiber optic imaging systems-advances. ENDOSCOPY: Introduction endoscopic imaging systems-fundamental, principles, advances, endoscopic diagnostic – advances endoscopic therapy –fundamentals.

UNIT-V:

CLINICAL APPLICATIONS OF FIBER OPTIC LASER SYSTEMS: Introduction ,fiber optic laser system in cardiovascular disease, gastroenterology. Gynecology, neurosurgery, oncology, ophthalmology, orthopedics, otolaryngology (ENT), urology, and flow diagram for laser angioplasty& photodynamic therapy.

Suggested Reading:

1. Laser and optical fibers in Medicine by Abraham Katzir, Academics Press,1998.

2. Therapeutic Lasers-Theory and Practice by G. David Baxter, Churchill Livingstone Publications.

3. Medical Lasers and their safe use DAVID H Shiney .Stephen and L Trokel, Springer, Springer. verlag publications.

4. Elements of fiber optics S.L.Wymer, Regents PHI.

5. Biomedical Electronics and Instrumentation S.K.Venkata Ram Galgotia publications.

PE 752BM

REHABILITATION ENGINEERING

(PROFESSIONAL ELECTIVE V)

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

Course Objectives:

- To extend knowledge of the amputee, of lost and remaining functions affecting locomotion, and to collect information on the best possible medical treatment.
- To improve fitting techniques and practices, including training, so that existing devices might be used with greater comfort and function.
- To develop improved lower-extremity devices.

Course Outcomes: Successfully the student will be able to:

1. Apply fundamental knowledge of engineering in rehabilitation
2. Apply analytical skills to assess and evaluate the need of the end-user
3. Develop self-learning initiatives and integrate learned knowledge for problem solving
4. Understand the basics of robotics and apply their principles in developing prosthetics
5. Apply the knowledge of computers in solving rehabilitation problems

UNIT- I

Introduction to Rehabilitation Engineering, Measurement and analysis of human movement, Disability associated with aging in the workplace and their solutions, clinical practice of rehabilitation engineering.

UNIT-II

Assistive Technology, Seating Biomechanics and systems. Wheeled Mobility: Categories of Wheelchairs. Wheelchair Structure and Component Design. Ergonomics of Wheel chair propulsion. Power Wheelchair Electrical Systems. Control. Personal Transportation. Auxiliary devices and systems.

UNIT – III

Sensory augmentation and substitution: Visual system: Visual augmentation. Tactual vision substitution, Auditory vision substitution; Auditory system: Auditory augmentation. Cochlear implantation, Visual auditory substitution, Tactual auditory substitution, Tactual system: Tactual augmentation. Tactual substitution. Measurement tools and processes: fundamental principles, structure, function; performance and behavior. Subjective and objective measurement methods.

UNIT–IV

Rehabilitation Robotics, Major Limb Prosthetic Devices, Orthotic Devices, Types of orthotics and prosthetics, Intelligent prosthetic Knee, Prosthetic Hand, Controlled orthotics and prosthetics FES system, Restoration of Hand function, Restoration of standing and walking, Myo-electric Hand.

UNIT-V

Augmentative and Alternative communication technology, Computer applications in Rehabilitation Engineering, telecommunications, and Web Accessibility.

Suggested Reading:

1. Robinson C.J., *Rehabilitation Engineering*, CRC Press, 1995.
2. Ballabio E., et al., *Rehabilitation Technology*, IOS Press, 1993.
3. Rory A Cooper, Hisaichi Ohnabe, Douglas A. Hobson, *Series in medical physis and biomedical engineering: An introduction to rehabilitation engineering*, Taylor and Francis Group, London, 2007.
4. Joseph D. Bronzino *The biomedical engineering handbook -biomedical engineering fundamentals*, 3rd Ed., CRC Press, Taylor & Francis Group, London, 2006.

HS 701 BM

HOSPITAL ADMINISTRATION AND MANAGEMENT

(PROFESSIONAL ELECTIVE V)

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

Course Objectives:

- To be familiar with the administration of all the departments in the hospitals.
- To understand the Hospital Planning and Information management.
- To learn the Equipment Maintenance Management

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

1. Familiar with Knowledge and skills necessary to competently manage a health care facility.
2. Know the roles and responsibilities of various departments present in the hospital.
3. Comprehend different services, Computer management in various departments in the hospital
4. Realize electrical supply and utilization of various equipments present in the hospital
5. Recognize the skills required for maintaining the Biomedical equipment and department.

UNIT – I

Introduction to Hospital Administration: Challenges of the hospital, Roles and functions of hospital administration, Role and evolution of hospitals, Types and Classification of Hospitals - Teaching-cum-Research Hospitals, General Hospital, Specialist Hospitals, P.H.C. Ethical and Legal aspects of hospital administration.

UNIT – II

Introduction to Management: Approaches to management, Principles of Management, Managerial activities of a hospital, Materials management. Hospital Planning – Principles, location, site selection, hospital planning team. Budgeting, equipping a hospital. Computers and Information Management in Hospitals: Admission/Discharge Records. Patient Billing. In-patient and OPD Registration, Pharmacy Management. Purchase and Inventory Control. Risk Management.

UNIT – III

Hospital Services: Clinical Services – Outpatient, Emergency, Inpatient, Intensive care unit, Operation Theater and Nursing. Diagnostic and Therapeutic Services – Laboratory, Radiology, Pharmacy and Transfusion. Support and Utility Services – Medical Records department, CSSD, Dietary, housekeeping and Public relations in hospitals. Ambulance, Fire Fighting and Safety services. Hospital Infection and Control. BME Services in Hospitals.

UNIT – IV

Electrical factors in Hospital Design, Layout and Centralization of Technical Services: Electrical Power Supply: Reliability, Three Phase Systems. Voltage stabilization. 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. Centralization: Commonality of technical services and centralization 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- AMC, CMC. Servicing Procedures: Servicing Schedules. Fault Diagnosis. Repairs and Modifications. Maintenance of Log Books. Implementation of Electrical Safety Codes and Standards, Stores Management. Functional Organization of a BME/Clinical Engineering Department.

Suggested Reading:

1. DC Joshi., and Mamatha Joshi., *Hospital Administration @2009, Jaypee Brothers Medical Publishers*, New Delhi.

2. BM Sakharkar, *Principles of Hospital Administration & Planning*, @ 2009. *Jaypee Brothers Medical Publishers*, New Delhi.

OE701BM

MICRO ELECTRO-MECHANICAL SYSTEMS

(OPEN ELECTIVE-II)

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

Course Objectives:

- To introduce to basics of Micro-electro-mechanical systems
- To understand properties of materials involved in MEMS
- To pertain fabrication methods involved in MEMS manufacturing
- To apply the concepts for various applications

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

1. Elucidate basic concepts involved in MEMS technologies
2. Realize the properties of various materials involved in MEMS technologies
3. Apply the concepts and technologies involved in designing of MEMS
4. Relate different manufacturing processes involved in fabrication of MEMS
5. Recognize micro sensors, micro actuators and their applications in various fields.

UNIT I

Introduction to MEMS: What is MEMS, Historical Background, classification, Micro-engineering, importance of micro-engineering. Technological advancements in MEMS, advantages and disadvantages of MEMS.

UNIT II

MEMS materials: Materials used in MEMS. Material properties: electrical, mechanical, thermal, chemical, biological, optical and processing. Reliability issues of materials

UNIT III

Designing of MEMS: Design and analysis process for MEMS. Initial design process, structured design process. Commonly used design flow, structured design flow. Design flow for MEMS cad design. Design and verification flow for integrated MEMS.

UNIT IV

MEMS fabrication Techniques: Photolithography, materials for micromachining, bulk micromachining Surface micromachining, High aspect-ration-micromachining, assembly and system integration.

UNIT V

MEMS structures and devices: Mechanical sensors, mechanical actuators, micro-fluidic devices, optical/photonic micro-systems, biological transducers.

Suggested Readings:

1. Adams TM, Layton RA. Introductory MEMS: Fabrication and applications, 2010.
2. Tobergte DR, Curtis S. "An Introduction to Micro-electro-mechanical Systems Engineering" Second Edition. vol. 53. 2013.
3. Kreith F, Kreider JF. :The MEMS Handbook" CRC Press 2002.
4. Reza Ghodssi · Pinyen Lin. "MEMS Materials and Processes Handbook" Springer 2013
5. Gad-el-Hak M. "MEMS applications" 2nd edition, CRC press 2006.

OE 702CE

GREEN BUILDING TECHNOLOGY

(OPEN ELECTIVE - II)

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

Course Objectives:

1. Exposure to the green building technologies and their significance.
2. Understand the judicial use of energy and its management.
3. Educate about the Sun-earth relationship and its effect on climate.
4. Enhance awareness of end-use energy requirements in the society.
5. Develop suitable technologies for energy management.

Course Outcomes: Student will be

1. Understand the fundamentals of energy use and energy processes in building.
2. Identify the energy requirement and its management.
3. Know the Sun-earth relationship vis-a-vis its effect on climate.
4. Be acquainted with the end-use energy requirements.
5. Be familiar with the audit procedures of energy.

UNIT- I

Overview of the significance of energy use and energy processes in building: Indoor activities and environmental control - Internal and external factors on energy use and the attributes of the factors - Characteristics of energy use and its management - Macro aspect of energy use in dwellings and its implications.

UNIT- II

Indoor environmental requirement and management: Thermal comfort - Ventilation and airquality – Air-conditioning requirement - Visual perception - Illumination requirement - Auditory requirement.

UNIT- III

Climate, solar radiation and their influences: Sun-earth relationship and the energy balance onthe earth's surface - Climate, wind, solar radiation, and temperature - Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings.

UNIT- IV

End-use, energy utilization and requirements: Lighting and day lighting - End-use energy requirements - Status of energy use in buildings Estimation of energy use in a building - Heat gain and thermal performance of building envelope - Steady and non-steady heat transfer through the glazed window and the wall - Standards for thermal performance of building envelope - Evaluation of the overall thermal transfer.

UNIT- V

Energy management options: Energy audit and energy targeting - Technological options forenergy management.

Suggested Readings:

1. Michael Bauer, Peter Mösle and Michael Schwarz, *"Green Building – Guidebook for Sustainable Architecture"*, Springer, Heidelberg, Germany, 2010.
2. Norbert Lechner, *"Heating, Cooling, Lighting - Sustainable Design Methods for Architects",* Wiley, New York, 2015.
3. Mike Montoya, *"Green Building Fundamentals*", Pearson, USA, 2010.
4. Charles J. Kibert, *"Sustainable Construction - Green Building Design and Delivery*", John Wiley & Sons, New York, 2008.
5. Regina Leffers, *"Sustainable Construction and Design*", Pearson / Prentice Hall, USA, 2009.
6. James Kachadorian, *"The Passive Solar House: Using Solar Design to Heat and Cool Your Home",* Chelsea Green Publishing Co., USA, 1997.

OE 703CS

INFROMATION SECURITY

(OPEN ELECTIVE - II)

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

Course Objectives:

- To learn legal and technical issues in building secure information systems
- To provide an understanding of network security
- To expose the students to security standards and practices

Course Outcomes: Student will be

1. Describe the steps in Security Systems development life cycle(SecSDLC)
2. Understand the common threats and attack to information systems
3. Understand the legal and ethical issues of information technology
4. Identify security needs using risk management and choose the appropriate risk control strategy based on business needs
5. Use the basic knowledge of security frameworks in preparing security blue print for the organization
6. Usage of reactive solutions, network perimeter solution tools such as firewalls, host solutions such as antivirus software and Intrusion Detection techniques and knowledge of ethical hacking tools
7. Use ethical hacking tools to study attack patterns and cryptography and secure communication protocols
8. Understand the technical and non-technical aspects of security project implementation andaccreditation

UNIT – I

Introduction: History, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access,the SDLC, the Security SDLC.

Need for Security: Business Needs, Threats, Attacks, and Secure Software Development

UNIT – II

Legal, Ethical and Professional Issues: Law and ethics in Information Security, Relevant U.S. Laws, International Laws and Legal Bodies, Ethics and Information Security.

Risk Management: Overview, Risk Identification, Risk Assessment, and Risk Control Strategies, Selecting a Risk Control Strategy, Quantitative versus Qualitative Risk Control Practices, Risk Management discussion Points, and Recommended Risk Control Practices.

UNIT – III

Planning for Security: Security policy, Standards and Practices, Security Blue Print, Security Education, Continuity strategies.

Security Technology: Firewalls and VPNs: Physical Design, Firewalls, And Protecting Remote connections.

UNIT – IV

Security Technology: Intrusion Detection, Access Control, and other Security Tools: Intrusion Detection and Prevention Systems-Scanning, and Analysis Tools- Access Control Devices.

Cryptography: Foundations of Cryptology, Cipher methods, Cryptographic Algorithms, Cryptographic Tools, Protocols for Secure Communications, Attacks on Cryptosystems

UNIT – V

Implementing Information Security: Information security project management, Technical topics of implementation, Non-Technical Aspects of implementation, Security Certification and Accreditation.

Security and Personnel: Positioning and staffing security function, Employment Policies and Practices, and Internal control Strategies.

Information Security Maintenance: Security management models, Maintenance model, and DigitalForensics.

Suggested Readings:

1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Cengage Learning, 2011.
2. Thomas R Peltier, Justin Peltier, John Blackley, "Information Security Fundamentals",Auerbach Publications, 2010.
3. Detmar W Straub, Seymour Goodman, Richard L Baskerville, "Information Security,Policy, Processes, and Practices", PHI, 2008.
4. Mark Merkow and Jim Breithaupt "Information Security Principle and Practices", Pearson Education, 2007

OE 704CS

DATA BASE MANAGEMENT SYSTEMS

(OPEN ELECTIVE - II)

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

Course Objectives:

- To introduce three schema architecture and DBMS functional components.
- To learn formal and commercial query languages of RDBMS.
- To understand the principles of ER modeling and theory of normalization.
- To study different file organization and indexing techniques.
- To familiarize theory of serializablity and implementation of concurrency control, andrecovery.

Course Outcomes: Student will be

1. Understand the mathematical foundations on which RDBMS are built.
2. Model a set of requirements using the Extended Entity Relationship Model (EER), transform an EER model into a relational model, and refine the relational model using theory of Normalization.
3. Develop Database application using SQL and Embedded SQL.
4. Use the knowledge of file organization and indexing to improve database application performance.
5. Understand the working of concurrency control and recovery mechanisms in RDBMS.

UNIT – I

Introduction: Database System Applications, Purpose of Database Systems, View of Values, Nested Sub-queries, Complex Queries, Views, Modification of the Database, Joined Relations Data, Database Languages, Relational Databases, Database Design, Object–based and Semi-structured Databases, Data Storage and Querying, Transaction Management, Data Mining and Analysis, Database Architecture, Database Users and Administrators.

Database Design and the E-R Model: Overview of the Design Process, The Entity-Relationship Model, Constraints, Entity-Relationship Diagrams, Entity – Relationship Design Issues, Weak Entity Sets, Extended E-R Features, Database Design for Banking Enterprise, Reduction to Relational Schemas, Other Aspects of Database Design

UNIT – II

Relational Model: Structure of Relational Databases, Fundamental Relational-Algebra Operations, Additional Relational – Algebra Operations, Extended Relational - Algebra Operations, Null Values, Modification of the Databases.

Structured Query Language: Data Definition, Basic Structure of SQL Queries, Set Operations, Aggregate Functions, Null

UNIT – III

Advanced SQL: SQL Data Types and Schemas, Integrity Constraints, Authorization, Embedded SQL, Dynamic SQL, Functions and Procedural Constructs, Recursive Queries, Advanced SQL Features. Relational Database Design: Features of Good Relational Design, Atomic Domains andFirst Normal Form, Functional-Dependency Theory, Decomposition using Functional Dependencies.

UNIT – IV

Indexing and Hashing: Basic Concepts, Ordered Indices, B^+-tree Index Files, B-tree Index Files, Multiple-Key Access, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices.

Index Definition in SQL Transactions: Transaction Concepts, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementationof Isolation, Testing for Serializability

UNIT – V

Concurrency Control: Lock-based Protocols, Timestamp-based Protocols, Validation-based Protocols, Multiple Granularity, Multi-version Schemes, Deadlock Handling, Insert and Delete Operations, Weak Levels of Consistency, Concurrency of Index Structures.

Recovery System: Failure Classification, Storage Structure, Recovery and Atomicity, Log-Based Recovery, Recovery with Concurrent Transactions, Buffer Management, Failure with Loss of Nonvolatile Storage, Advanced Recovery Techniques, Remote Backup Systems.

Suggested Readings:

1. Abraham Silberschatz, Henry F Korth, S Sudarshan, "*Database System Concepts"*, McGraw-Hill International Edition, 6th Edition, 2010.
2. Ramakrishnan, Gehrke, "*Database Management Systems"*, McGraw-Hill InternationalEdition, 3rd Edition, 2003.
3. Elmasri, Navathe, Somayajulu, "*Fundamentals of Database Systems"*, Pearson Education,4th Edition, 2004.

OE 705EC

EMBEDDED SYSTEMS

(OPEN ELECTIVE - II)

Instruction: 3L hours per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To gain knowledge to design embedded systems.
- To understand the processor selection criteria for Embedded System Design.
- To gain the knowledge of ARM Cortex on Zynq for embedded systems.
- To gain the knowledge of tool chain for embedded systems.
- To understand the importance of RTOS in building real time systems

Course Outcomes: Student will be

1. Design an embedded system.
2. Distinguish between RISC and CISC
3. Use the ARM Cortex for design of embedded system
4. Use Embedded Software Development Tools for Designing Embedded System applications
5. Apply their understanding in building real time systems

UNIT-I

Introduction To Embedded Systems: The Embedded Design Life Cycle - Product Specification, Hardware/Software Partitioning, Iteration and Implementation, Detailed Hardware (selection fo processor) and Software Design, Hardware/Software Integration, Product Testing And Release, Maintenance and Upgradation.

UNIT-II

ARM Embedded Systems: The RISC design philosophy, The ARM design philosophy, ARM processor fundamentals, registers, current program status register, pipeline, exceptions, interrupts,and vector table, core extensions, architecture revisions, ARM processor families.

UNIT-III

Embedded processing with ARM CORTEX on Zynq: Fundamentals of FPGA, types of FPGA, case study of Xilinx FPGA, Processing System, programmable logic, programmable logic interfaces, security, Zynq 7000 family members, Zynq versus standard FPGA, Zynq versus standard processor.

UNIT-IV

Embedded Software Development Tools: Host and Target Machines, Cross Compilers, Cross Assemblers, Tool Chains, Linkers/Locators for Embedded Software, Address Resolution, and LocatorMaps. Getting Embedded Software into Target System: PROM programmer, ROM emulator, In Circuit- Emulators, Monitors, Testing on Your Host Machine - Instruction Set Simulators, Logic Analyzers.

UNIT-V

Introduction to Real Time Operating Systems: Tasks and task states, tasks and Data, Semaphores and shared data. Operating system services: Message queues, mailboxes and pipes, timer functions,events, memory management, Interrupt routines in an RTOS environment.

Suggested Readings:

1. Arnold S Berger, "Embedded Systems Design", South Asian edition, CMP Books, 2005.
2. Andrew Sloss, Dominic Symes, Chris Wright, ARM "System Developer's Guide: Designing and Optimizing System Software", Elsevier, 2004.
3. Louise H Crockett, Ross. A. Elliot et al "The Zynq Book", Edition 1, Strathclyde academic media, July 2014.
4. David E Simon, "An Embedded software primer", Pearson, 2012

OE 706EC

VERILOG HDL

(OPEN ELECTIVE - II)

Instruction: 3L hours per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To familiarize with various modeling styles: structural, dataflow and behavioral of Verilog HDL.
- To develop combinational and sequential circuits using various modeling styles of Verilog HDL
- To design and develop Verilog HDL models of data path and control units of Central Processing Unit (CPU)
- To learn Synthesis and FPGA design flow.
- To design and develop real time applications: Booth's multiplier, Divider, hardwired control for basic CPU, FIR filter.

Course Outcomes: Student will be

1. Implement and distinguish different Verilog HDL modeling styles
2. Construct and analyze Verilog HDL models of combinational and sequential circuits
3. Design and develop Verilog HDL modeling and test bench for digital systems for the given specifications
4. Outline FPGA design flow and timing analysis

UNIT - I

Introduction to HDL: Overview and Importance of HDLs, Differences between HLL, HDL and ALP. Design methodologies, Modules, Lexical Conventions, Number Specifications, Strings, Identifiers and Keywords Data types, System task and compiler Directives, Port declaration and port connection rules

UNIT - II

Structural and Dataflow modeling: gate-level modeling, delays, hazards, dataflow modeling: Continuous Assignments, Delays, Expressions, Operators and Operands, Operator Types and Design Examples

UNIT - III

Behavioral Modeling: Structured Procedures, Procedural Assignments, Timing Controls, Conditional Statements, multi-way branching, Loops, Sequential and Parallel blocks, Generate blocks. Combinational, sequential logic modules Simulation: Types of Simulation, Event driven Simulation and Cycle Based Simulation; design examples.

UNIT - IV

Synthesis and Verification: Tasks and Functions: Differences between Tasks and Functions, Tasks and Functions. Verilog HDL synthesis, synthesis, Application Specific IC (ASIC) and Field Programmable Gate Array (FPGA) design flow. Verification: Timing analysis and Test bench design. Design examples.

UNIT - V

Real time implementations: Fixed-Point Arithmetic modules: Addition, Multiplication, Division, Arithmetic and Logic Unit (ALU), Timer, Universal Asynchronous Receiver and Transmitter (UART), DSP modules: FIR and IIR filters, CPU design: Data path and control units.

Suggested Reading:

1. Samir Palnitkar, "Verilog HDL A Guide to Digital Design and Synthesis," 2nd Edition, Pearson Education, 2006.

2. Ming-Bo Lin, "Digital System Designs and Practices: Using Verilog HDL and FPGA," Wiley India Edition, 2008.

3. J. Bhasker, "A Verilog HDL Primer," 2nd Edition, BS Publications, 2001.

OE 707EC

SATELLITE COMMUNICATION AND APPLICATIONS

(OPEN ELECTIVE - II)

Instruction: 3L hours per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To familiarize with basic concepts related to satellite Communication.
- To understand Sub-Systems of Satellites and Launches.
- To design the Earth Station antennas.
- To know about the parameters affecting the Satellite System Performance.
- To understand the applications of satellites.

Course Outcomes: Student will be

1. Able to have knowledge about the Satellite communications Principles and Properties.
2. Able to know about the Space craft subsystems and Launch vehicles.
3. Able to design the Satellite Earth station antennas
4. Able to analyze the effects of various parameters on Satellite System performance.
5. Able to understand the applications of Satellite Communication.

UNIT–I

Origin of Satellite communications, A Brief History of Satellite Communication, Basic principles and properties of satellite communication. Earth segment, Space segment, Interpretation of Kepler's Laws. Orbital Mechanics: The Equation of the Orbit, Describing the Orbit, Locating the Satellite in the Orbit, Orbital effects in communication system Performance: Doppler shift, Range variation, Eclipse and Sun-Transit Outage.

UNIT– II

Space craft sub systems, Equipment Reliability and Space Qualification: Space Qualification, Reliability, and Redundancy, Satellite launch and launch vehicles and Mechanics of Launching a Synchronous Satellite.

UNIT– III

Earth Stations: Earth Station Design for Low System Noise Temperature, Design of large antennas and small earth station antennas. Low noise amplifiers and High power Amplifiers for Satellite communication.

UNIT– IV

Satellite Link Design: Basic Transmission Theory, System Noise Temperature and G/T ratio: Noise Temperature, calculation of System Noise Temperature, Noise Figure and Noise Temperature, Propagation on Satellite-Earth paths: Attenuation, depolarization, atmospheric absorption, Tropospheric Multipath effects and Land and Sea Multipath, Multipath Effects in System Design,Faraday rotation in the Ionosphere, Ionospheric scintillations, Rain and ice effects.

UNIT– V

Satellite Navigation Applications: Global and Regional Satellite Navigation Systems- Operating Principles, Advantages, Limitations, Current Status and Applications, Remote Sensing Satellites.

Suggested Readings:

1. Wilbur L. Pitchand and Henri G. Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", 2nd edn.3rd Impression, Pearson Education.2008.
2. Timothy Pratt and Charles Nestian. W, "Satellite Communication", John Wiley and Sons, 1988.
3. Tri T. Ha, "Digital Satellite Communication", Tata McGraw- Hill, Special Indian Edition 2009.

OE708EE

OPTIMIZATION TECHNIQUES

(Open Elective-II)

Instruction: 3 Periods per week
CIE: 30 Marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 Marks

Course Objectives

- To understand the need and basic concepts of operations research and classify the optimization problems.
- To study about the linear programming and non-linear programming concepts and their applications
- To understand various constrained and un-constrained optimization techniques and their applications.
- To understand the concepts and implementation of Genetic Algorithms to get the optimum solutions
- To study the concepts of Metaheuristics Optimization techniques

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

1. Analyze any problem of optimization in an engineering system and able to formulate a mathematical model to the problem and solving it by the techniques that are presented.
2. Solve problems of L.P. by graphical and Simplex methods
3. Apply various constrained and un-constrained optimization techniques for the specific problems.
4. Could able to implement the Genetic Algorithms to solve the for optimum solution
5. Understands the concepts to use the Metaheuristics Optimization techniques

UNIT-I

Introduction: Definitions, Characteristics, Objective function, Classification of optimization problems, Engineering applications and limitations. Single-Variable Optimization, Multivariable Optimization with No Constraints, Multivariable Optimization with Equality Constraints and Multivariable Optimization with Inequality Constraints: Kuhn–Tucker Condition

UNIT-II

Linear Programming: Definitions and Formulation of the LPP, Construction of L.P. Models, Slack and surplus variables, Standard form, Canonical form and matrix form of LP Problems. Artificial Variables, solution by the Big-M method, Duality principle, Dual problems and numerical problems.

UNIT-III

Random Search Methods concepts: Direct Search Methods - Univariate Method, Gradient of a Function, Indirect Search Methods - Gradient of a Function, Steepest Descent (Cauchy) Method, Newton's Method.

UNIT-IV

Binary Genetic Algorithm: Genetic Algorithms Natural Selection on a Computer, Components of a Binary Genetic Algorithm. Selecting the Variables and the Cost Function. Variable Encoding and Decoding, The Population, Natural Selection, Selection, Mating. Mutations, the Next Generation and Convergence, Components of a Continuous Genetic Algorithm.

UNIT-V

Metaheuristics Optimization: Concepts of Simulated Annealing, Theoretical approaches, Advantages and disadvantages, applications, Ant Colony Algorithms - Introduction, Collective behavior of social insects, Formalization and properties of ant colony optimization.

Suggested Reading:

1. Rao, S.S. (2009). "Engineering Optimization: Theory and Practice." John Wiley & Sons, Inc.
2. Taha, H.A. (2008). "Operations Research, Pearson Education India." New Delhi, India.
3. Randy L. Haupt and Sue Ellen Haupt, "Practical genetic algorithms" second edition, a John Wiley & sons, inc., publication -2004.
4. Sharma J.K. (2013). "Operation Research: Theory and Applications." Fifth Edition, Macmillan Publishers, New Delhi, India.
5. J. Dreo A. Petrowski, P. Siarry E. Taillard. "Metaheuristics for Hard Optimization" Springer.

OE709EE

NON-CONVENTIONAL ENERGY SOURCES

(Open Elective-II)

Instruction: 3 Periods per week
CIE: 30 Marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 Marks

Course Objectives

- To understand the different types of energy sources
- To Understand the need of non-conventional energy sources and their principles
- To understand the limitations of non-conventional energy sources
- To outline division aspects and utilization of renewable energy sources for diriment application.
- To analyze the environmental aspects of renewable energy resources

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

1. Know the different energy resources and need of renewable energy resources
2. Understand the concepts of working of fuel cell systems along with their applications
3. Describe the use of solar energy and the various components and measuring devices used in the energy production and their applications
4. Appreciate the need of Wind Energy and their classification and various components used in energy generation and working of different electrical wind energy system
5. Understand the concept of OTEC technology, Biomass energy resources and different types of biogas Plants used in India

UNIT-I

Review of Conventional and Non-Conventional energy sources, Need for non-conventional energy sources Types of Non-conventional energy sources, Fuel Cells, Principle of operation with special reference to H2O2 Cell, Classification and Block diagram of fuel cell systems, Ion exchange membrane cell, Molten carbonate cells, Solid oxide electrolyte cells, Regenerative system, Regenerative Fuel Cell, Advantages and disadvantages of Fuel Cells, Polarization, Conversion efficiency and Applications of Fuel Cells.

UNIT-II

Solar energy, Solar radiation and its measurements, Solar Energy collectors, Solar Energy storage systems, Solar Pond, Application of Solar Pond, Applications of solar energy.

UNIT-III

Wind energy, Principles of wind energy conversion systems, Nature of wind, Power in the Wind, Basic components of WECS, Classification of WECS, Site selection considerations, Advantages and disadvantages of WECS, Wind energy collectors, Wind electric generating and control systems, Applications of Wind energy, Environmental aspects.

UNIT-IV

Energy from the Oceans, Ocean Thermal Electric Conversion (OTEC) methods, Principles of tidal power generation, Advantages and limitations of tidal power generation, Ocean waves, Wave energy conversion devices, Advantages and disadvantages of wave energy, Geo-thermal Energy, Types of Geo-thermal Energy Systems, Applications of Geo-thermal Energy.

UNIT-V

Energy from Biomass, Biomass conversion technologies / processes, Photosynthesis, Photosynthetic efficiency, Biogas generation, Selection of site for Biogas plant, Classification of Biogas plants, Details of commonly used Biogas plants in India, Advantages and disadvantages of Biogas generation, Thermal gasification of biomass, Biomass gasifies.

Suggested Reading:

1. Rai G.D, Non-Conventional Sources of Energy, Khandala Publishers, New Delhi, 1999.
2. M. M. El-Wakil, Power Plant Technology. McGraw Hill, 1984.

With effect from the academic year 2021-2022

OE 711ME

STARTUP ENTREPRENEURSHIP

(Open Elective - II)

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

Course Objectives:

- To motivate students to take up entrepreneurship in future
- To learn nuances of starting an enterprise by creative thinking and shape ideas intoreality.
- To understand action driven business plan and learn to prepare project budget.

Course Outcomes: Student will be able to

1. Think creatively and transform ideas into reality.
2. Differentiate market transforming strategy.
3. Create *a complete business plan and workout the budget plan.*

UNIT – I

Creativity & Discovery: Definition of Creativity, self-test creativity, discovery and delivery skills, The imagination threshold, Building creativity ladder, Collection of wild ideas, Bench marking the ideas, Innovative to borrow or adopt, choosing the best of many ideas, management of tradeoff between discovery and delivery, Sharpening observation skills, reinventing self, Inspire and aspire through success stories

UNIT – II

From Idea to Startup: Introduction to think ahead backward, Validation of ideas using cost and strategy, visualizing thebusiness through value profile, activity mapping, Risks as opportunities, building your own road map

UNIT – III

Innovation career lessons: Growing & Sharing Knowledge, The Role of Failure In Achieving Success, Creating vision, Strategy, Action & Resistance: Differentiated Market Transforming Strategy; Dare to TakeAction; Fighting Resistance; All About the startup Ecosystem; Building a Team; Keeping it Simple and Working Hard.

UNIT – IV

Action driven business plan: Creating a completed non-business plan (a series of actions each of which moves your idea toward implementation), including a list of the activities to be undertaken, with degrees of importance (scale of 1 to 3, where 1 is 'most important'). A revision of the original product or service idea, in light of information gathered in the process, beginning to design the business or organization that will successfully implement your creative idea. Preparing an activity map.

UNIT – V

Startup financing cycle: Preparing an initial cash flow statement, showing money flowing out (operations; capital) and flowing in. Estimate your capital needs realistically. Prepare a bootstrapping option (self-financing). Prepare a risk map. Prepare a business plan comprising five sections: The Need; The Product; Unique Features; The Market; Future Developments. Include a Gantt chart (project plan – detailed activities and starting and ending dates); and a project budget.

Suggested Readings:

1. Vasant Desai, *"Dynamics of Entrepreneurial Development and Management"*, Himalaya Publishing House, 1997.
2. Prasanna Chandra, *"Project – Planning, Analysis, Selection, Implementation and Review",* Tata McGraw-Hill Publishing Company Ltd., 1995.
3. B. Badhai, "*Entrepreneurship for Engineers*", Dhanpath Rai & Co., Delhi, 2001.
4. Stephen R. Covey and A. Roger Merrill, "*First Things First",* Simon and Schuster, 2002.
5. Robert D. Hisrich and Michael P.Peters, *"Entrepreneurship*", Tata McGraw HillEdition, 2002.

OE712ME

NANO TECHNOLOGY

(Open Elective - II)

Instructions: (3L) hrs per week
CIE: 30 Marks
Credits: 3

Duration of SEE: 3hours
SEE: 70 Marks

Course Objectives:

- To familiarize Nano materials and technology.
- To understand Nano structures, fabrication and special Nano materials.
- Course Outcomes:

Course Outcomes:

1. Upon successful completion of this course, the student will be able to:
2. Apply the nano materials to different industrial applications
3. Explore the nano materials various human applications
4. Design and manufacture nanomaterial processes

UNIT-I

Introduction: Nanoscale, Properties at Nanoscale, advantages and disadvantages, importance of Nano Technology, Bottom-up and Top-down approaches, challenges in NanoTechnology.

UNIT-II

Materials of Nano Technology: Introduction-Si-based materials, Ge-based materials, Smart materials, metals, Ferroelectric materials, Polymer materials, GaAs & InP (III-V) group materials, Nano tribology and Materials, Principles and analytical techniques of XRD, SEM, TEM and STM/AFM.

UNIT-III

Nano Structures: Zero dimensional Nano structure (Nano Particles)- Synthesis procedure, characterization techniques, properties and applications of Nano Particles

One dimensional Nano structures (Nano Wires, Nano Tubes)- Various Synthesis procedure, characterization procedure and principles involved, properties and applications of Nano Wires, Types of Nano Tubes, Synthesis procedure, characterization properties and applications of Nano Tubes.

UNIT-IV

Nano Fabrication: Introduction, Basic fabrication techniques (Lithography, thin film deposition, and doping) MEMS fabrication techniques, Nano fabrication techniques (E-beam Nano-imprint fabrication, Epitaxy and strain engineering, Scanned probe techniques).

UNIT-V

Special Nano Materials: Nano Composites: Introduction, Synthesis procedures, various systems (metal-polymer, metal- ceramics and polymer-Ceramics), Characterization procedures, applications. Nano Biomaterials: Introduction, Biocompatibility, anti-bacterial activity, principles involved, applications.

Suggested Reading:

1. A.K. Bandyopadyay, Nano Materials, New Age Publications, 2007.
2. T. Pradeep, Nano: The Essentials: Understanding Nanoscience and Nanotechnolgy, Tata McGraw-Hill, 2008.
3. Carl. C. Koch, Nano Materials Synthesis, Properties and Applications, Jaico Publishing House, 2008.
4. Willia Illsey Atkinson, NanoTechnology, Jaico Publishing House, 2009.

PC751 BM

BIOMEDICAL SIGNAL PROCESSING LAB

Instruction:	2 Periods per week
Duration of University Examination:	2 Hours
University Examination	50 Marks
Sessional:	25 Marks
Credits 1	

Course Objectives:

- Understand the need for adaptive filters
- Understand the signal processing techniques used for biosignals
- Comprehend the concepts of design and their application in medicine

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

1. Design and implement digital filters for noise reduction of biological signals
2. Implement various feature extraction algorithms on biosignals
3. Identify different types of noises and filters used in biomedical signal processing
4. Perform data compression techniques.
5. Process the EEG signal and analyze it

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

PC 752 BM

MEDICAL IMAGE PROCESSING & MODELING LAB

Instruction:	2 Periods per week
Duration of University Examination:	2 Hours
University Examination	50 Marks
Sessional:	25 Marks
Credits 1	

Course Objectives:

- To perform enhancement techniques on images.
- To execute the noise models and filtering methods.
- To analyze the images by applying segmentation methods.

Course Outcomes: The student will be able to:

1. Execute and familiarize with the image enhancement techniques
2. Demonstrate filtering procedures on images.
3. Perform Image histogram and Histogram Equalization
4. Illustrate image segmentation techniques on the images and analyze them.
5. Exemplify modeling of 3D models.

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
13. Importing images and stl file.
14. Segmentation of liver/hip
15. Creating the 3D object of the liver/hip.

PW 751 BM

MAJOR PROJECT PHASE - I

Instruction	4 Periods per week
End Semester Evaluation	50 Marks
Credits	2

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

1. Synthesize knowledge and skills previously gained and apply these 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. 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 project 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.

P**C961BM**

SUMMER INTERNSHIP

Instruction: Six weeks in Summer vacation

CIE : 50 Marks

Course Objectives:

- To enhance practical and professional skills of the students
- To expose the students to hospital/ medical industry practices and team work
- To provide training to the students in soft skills, presentation skills and technical report writing

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

1. Acquire practical knowledge and skills required in a hospital/medical industry.
2. Realize the industry work culture and environment.
3. Prepare and present technical report

GUIDELINES:

Summer Internship is introduced as part of the curriculum for encouraging students to work on problems of interest to medical professionals. This will be for 6-8 weeks during the summer vacation following the completion of the VI semester. Students may be divided into batches of 3 students. Apart from being exposed to the practical aspects, the students may also work on a specified task or project assigned to them. The work progress will be monitored by one faculty coordinator and one coordinator from hospital/industry.

After the completion of the internship, students will submit a brief technical report the outcome of the internship and present the work through a seminar in the Department during the VII semester. The evaluation and award of credits based on the performance of the students is done by a committee constituted by the Head of the department.

With effect from the academic year 2021-2022

SCHEME OF INSTRUCTION

B.E. (BIOMEDICAL ENGINEERING) VIII - SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction			hr/ week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
1	**Professional Elective VI**		3	0	0	3	30	70	3
	PE 861 BM	Artificial Intelligence and Neural Networks in Medicine							
	PE 862 BM	Medical Device Regulations							
2	OE	**Open Elective III**	3	0	0	3	30	70	3
	Practicals								
3	PW 851 BM	Major Project Phase – II / Industrial Internship	0	0	12	12	50	100	6
		Total	**6**	**0**	**12**	**18**	**110**	**240**	**12**

L-Lectures; T-Tutorials; P-Practicals; CIE-Continuous Internal Evaluation; SIE-Semester End Evaluation

Open Elective-III

S.No.	Course Code	Course Title
1.	OE801BM	Basic Medical Equipment
2.	OE802CS	Data Science Using R
3.	OE803EC	Mobile Communication
4.	OE804EC	Internet of Things and Applications
5.	OE805EC	Global and Regional Satellite Navigation System
6.	OE806EE	Application of Electrical Energy
7.	OE807ME	Composite Material Applications
8.	OE808ME	Industrial Administration and Financial Management
9.	OE 809CS	Software Engineering
10.	OE810CS	Python Programming
11.	OE811CS	Cyber Security

PE861 BM

ARTIFICIAL INTELLIGENCE & NEURAL NETWORKS IN MEDICINE

(PROFESSIONAL ELECTIVE VI)

Instruction: 3 Periods per week — Duration of SEE: 3 hours
CIE: 30 Marks — SEE: 70 Marks
Credits: 3

Course Objectives:

- Understand the role of artificial intelligence and neural networks in engineering
- Provide knowledge of control strategies and search techniques
- Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic, and learning.
- Provide knowledge of supervised and unsupervised learning using neural networks.
- Apply AI and ML algorithms in medical applications

Course Outcomes: The student will be able to:

1. Apply the concepts and search techniques of artificial intelligence.
2. Represent the knowledge base using predicate calculus.
3. Perform knowledge representation using non-monotonic logic.
4. Familiarize with the concepts of Artificial Neural networks.
5. Apply the Artificial Intelligence algorithms in the field of medicine.

UNIT-I

Introduction to Artificial Intelligence: Definition. AI Applications, AI representation. Properties of internal Representation, General problem solving, production system, control strategies: forward and backward chaining. Uninformed and informed search techniques. A* and AO* Algorithm

UNIT-II

Knowledge representation using predicate logic: predicate calculus, Predicate and arguments, resolution and unification Semantic, Frame System, Scripts, conceptual Dependency

UNIT-III

Knowledge representation using non-monotonic logic: TMS (Truth maintenance system), statistical and probabilistic reasoning, fuzzy logic, structure knowledge representation

UNIT-IV

Introduction to Artificial Neural Network, network parameters, hebb rule, delta rule, supervised and unsupervised learning, pattern recognition problems, perception learning algorithm, Back propagation network-structure and algorithm

UNIT-V

Application of Artificial Intelligence & Neural Networks in Medicine – AI in Diagnosis-ELISA Model, automated drug delivery systems, Tumor Boundary Detection, cardiovascular applications

Suggested Reading:

1. Eugene, Charniak, Drew Mcdermott: Introduction to artificial intelligence.

2. Elaine Rich and Kerin Knight, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill- 2008.

3. Donna L. Hudson, Maunee E. Cohan, Neural Networks & Artificial Intelligence for Biomedical Engineering, Prentice Hall of India, New Delhi - 2001.
4. Kishen Mehrotra, Sanjay Rawika, K Mohan; Artificial Neural Network

5. Laurene Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", PEI 3rd Edition, 2008.

PE862 BM

MEDICAL DEVICE REGULATIONS

(PROFESSIONAL ELECTIVE VI)

Instruction: 3 Periods per week
CIE: 30 Marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 Marks

Course Objectives:

- To understand the medical device classes and regulatory efforts
- To understand the of national and international medical device regulations and standards
- To know about the patents and intellectual property rights.

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

1. Differentiate the medical devices under their respective classes.
2. Design medical products using different methodologies
3. Deliver the rules of Indian Medical Device Regulations-2017
4. Understand the product safety and legal issues
5. Apply the concepts in design of medical equipment.

UNIT I

Definition of Testing, Parsing Test Requirements, Test Protocol, Test Methodology, Purpose of the test, Failure Definition, Determining Sample Size and Test Length, Types of Testing.

Analysis of Test Data- Failure Rate, Mean Time between Failure, Reliability, Confidence Level, Confidence Limits, Minimum Life, Graphical Analysis.

Reliability And Liability- Negligence, Strict Liability, Breach Of Warranty, Defects, Failure To Warn Of Dangers, Plaintiff's Conduct, Defendants' Conduct, Defendant Related Issues, Manufacturers And Physicians Responsibilities, Accident reconstruction and forensics.

UNIT II

Food And Drug Administration- History of Device Regulation, Device Classification, Registration And Listing, 510(K) Process, Declaration Of Conformance To A Recognized Standard, PMA Application, Investigational Device Exemptions, Good Laboratory Practices, Good Manufacturing Practices, Human Factors, Design Control, FDA And Software, Software Classification, FDA Inspection, Advice On Dealing With The FDA Regulations And Standards- Definition OFA Medical Device, MDD, United States Domestic Standards, Rest Of The World Standards

UNIT III

Indian Medical Device Rules and Regulations-2017 Licensing Patents Copyrights and Trade Secrets Patents, Copyrights, Trademarks, Trade Secrets. Manufacturing and quality control- GMP regulations, design for manufacturability, design for assembly, manufacturing process.

UNIT IV

Miscellaneous Issues- Learning From Failure, Design For Failure, Design For Convenience, Universal Design, Design For Assembly, Prevention Through Design, Design For The Environment, Poka-Yoke, Product Life Issues, Product Testing Issues. Product Issues- Product Safety And Legal Issues, Accident Reconstruction And Forensics, Biomechanics And Traffic Accident Investigations. Professional Issues- BME – Related Professional Societies, Standards Setting Groups, Professional Engineering Licensure, Rules Of Professional Conduct, Codes Of Ethics, Forensics And Consulting, Continuing Education.

UNIT V

Design of Case studies: Multidetector brain scanning system development, testing of anesthetists, apnea detection system, cancer clinic charting, EKG analysis techniques & module.

Suggested Reading:

1. Design of Biomedical Devices and systems (Paul H. King & Richard C. Fries)

With effect from the academic year 2021-2022

OE801 BM

BASIC MEDICAL EQUIPMENT

(OPEN ELECTIVE-III)

Instruction: 3 Periods per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- To make the students understand the need for several Biomedical Equipments.
- To make the students understand the operating principles of a wide range of Biomedical Equipment.

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

1. Learn about various physiological parameters, monitoring and recording.
2. Assess the need and operating principle of equipment used in physiotherapy
3. Interpret the working principle and operating procedure and applications of Medical Imaging equipments.
4. Perceive the governing principles and functions of critical care equipments.
5. Learn about the various Therapeutic Equipment used for different applications

UNIT-I

Medical Monitoring and recording: Patient monitoring: System concepts, bedside monitoring systems, central monitors, heart rate and pulse rate measurement. Temperature measurement Blood pressure measurement: Direct and indirect methods. Respiration rate measurement: Impedance pneumograph, Apnoea detectors. Ambulatory monitoring: Arrhythmia monitor,

UNIT-II

Physiotherapy and Electrotherapy Equipment: Diathermy machines: Short wave diathermy, Microwave diathermy and ultrasonic diathermy Electro diagnostic/Therapeutic apparatus: Nerve muscle stimulator, Functional electrical stimulator etc.

UNIT-III

Medical Imaging Equipment:

X-Ray machines: Properties and production of X-Rays, X-ray machine, Image Intensifier. X-ray computed tomography: basic principle and construction of the components. Ultrasonic Imaging: Physics of ultrasonic waves, medical ultrasound, basic pulse echo apparatus. Magnetic Resonance Imaging: Principle, Image reconstruction techniques, Basic NMR components, Biological effects, Merits.

UNIT-IV

Critical care Equipment:

Ventilators: Mechanics of respiration, artificial ventilators, Positive pressure ventilator, Types and classification of ventilators. Drug delivery system: Infusion pumps, basic components, implantable infusion system, closed loop control in infusion pump. Cardiac Defibrillators: Need for defibrillators, DC defibrillator, Implantable defibrillators, Defibrillator analyzer.

UNIT-V

Therapeutic Equipment:

Cardiac pacemakers: Need for cardiac pacemakers, External and implantable pacemakers, types.
Dialysis Machine: Function of kidney, artificial kidney, Dialyzers, Membranes, Hemodialysis machine.
Lithotripters: The stone diseases problem, Modern Lithotripter systems, extra corporeal shockwave therapy.

Suggested Readings:

1. R.S.Khandpur, Hand Book of Biomedical Instrumentation, Tata McGrawHill, Second Edition, 2014.

2. John G.Webster, Medical Instrumentation Application and design, Wiley India Edition, 2009.

OE 802CS

DATA SCIENCE USING R

(OPEN ELECTIVE - III)

Instruction: (3L) hours per week Duration of SEE: 3 hours
CIE: 30 marks SEE: 70 marks
Credits: 3

Course Objectives:

- To learn basics of R Programming environment: R language, R- studio and R packages
- To learn various statistical concepts like linear and logistic regression, cluster analysis, time series forecasting
- To learn Decision tree induction, association rule mining and text mining

Course Outcomes: Student will be able to

1. Use various data structures and packages in R for data visualization and summarization
2. Use linear, non-linear regression models, and classification techniques for data analysis
3. Use clustering methods including K-means and CURE algorithm

UNIT- I

Introduction to R: Introduction, Downloading and Installing R, IDE and Text Editors, Handling Packages in R.

Getting Started with R: Introduction, Working with Directory, Data Types in R, Few Commands for Data Exploration.

Loading and Handling Data In R: Introduction, Challenges of Analytical Data Processing, Expression, Variables, Functions, Missing Values Treatment In R, Using 'As' Operator To Change The Structure Of The Data, Victors, Matrices, Factors, List, Few Common Analytical Tasks, Aggregation And Group Processing Of A Variable, Simple Analysis Using R, Methods For Reading Data, Comparison Of R GUI's For Data Input, Using R With Databases And Business Intelligence Systems.

UNIT- II

Exploring Data In R: Introduction, Data Frames, R Functions for Understanding Data in Data Frames, Load Data Frames, Exploring Data, Data Summary, Finding the Missing Values, Invalid Values and Outliers, Descriptive Statistics, Spotting Problems In Data with Visualization.

UNIT- III

Linear Regression Using R: Introduction, Model Fitting, Linear Regression, Assumptions of Linear Regression, Validating Linear Assumption.

Logistic Regression: Introduction, What Is Regression? Introduction to Generalized Linear Model, Logistic Regression, Binary Logistic Regression, Diagnosing Logistic Regression, Multinomial Logistic Regression Model.

UNIT- IV

Decision Tree: Introduction, What Is a Decision Tree? Decision Tree Representation In R, Appropriate Problems For Decision Tree Learning, Basic Decision Tree Learning Algorithm, Measuring Features, Hypothesis Space Search In Decision Tree Learning, Inductive Bias In Decision Tree Learning, Why Prefer Short Hypotheses, Issues In Decision Tree Learning.

Time Series in R: Introduction, What Is Time Series Data, Reading Time Series Data, Decomposing Time Series Data, Forecasts Using Exponential Smoothing, ARIMA Models.

UNIT- V

Clustering: Introduction, What Is Clustering, Basic Concepts in Clustering, Hierarchical Clustering, K-Means Algorithm, CURE Algorithm, Clustering in Non-Euclidean Space, Clustering for Streams and Parallelism.

Association Rules: Introduction, Frequent Item set, Data Structure Overview, Mining Algorithm Interfaces, Auxiliary Functions, Sampling from Transaction, Generating Synthetic Transaction Data, Additional Measures of Interestingness, Distance Based Clustering Transaction and Association.

Text Mining: Introduction, Definition of Text Mining, A Few Challenges in Text Mining, Text Mining Verses Data Mining, Text Mining In R, General Architectures of Text Mining Systems, Pre-Processing of Documents In R, Core Text Mining Operations, Using Background Knowledge for Text Mining, Text Mining Query Languages.

Mining Frequent Patterns, Associations and Correlations: Basic Concepts and Methods.Frequent Item set, Closed Item set And Association Rules.

Frequent Item set: Mining Methods, Pattern Evaluation Methods, and Sentiment Analysis

Suggested Readings:

1. Seema Acharya, “Data Analytics using R”, McGraw Hill education.
2. Nina Zumel and John Mount, “Practical Data Science with R”, Manning Shelter Island.
3. Crawley, Michael J., “ The R book”, John Wiley & Sons, Ltd

With effect from the academic year 2021-2022

OE 803EC

MOBILE COMMUNICATION

(OPEN ELECTIVE - III)

Instruction: (3L) hours per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- Understand basics of Cellular systems, their generations and Characteristics of Mobile Communications.
- Understand the Frequency reuse mechanism for Mobile operations and Co-Channel interference concepts
- Understand the Mobile signal Coverage in different terrains and Lee models
- Understand the working of Antennas at Cell-site and at Mobile units.
- Understand the various Handoff mechanisms and Concept of Dropped calls

Course Outcomes: Student will be

1. Able to analyze the various operational features of Mobile Communication Systems
2. Able to deal with the Mobile communication system designs of Frequency re-use and Interference Factors
3. Able to carry out the Design aspects of Mobile signal coverage over different terrains
4. Able to analyze the different Cell-site and Mobile antennas for different applications
5. Able to characterize the Handoffs mechanisms.

UNIT – I

Introduction to Cellular Mobile Communications:

History of Mobile cellular: AMPS system (First-generation systems), Second-generation System, 3G Systems, 4G Systems, 5G Systems, Other Cellular-like Systems, Spectrum allocation, Spectrum Efficiency Considerations.

Basic Cellular systems, Circuit-Switched and Packet-Switched Systems, Performance criteria, Voice quality, Data quality, Picture quality, Service quality and special features.

Uniqueness of Mobile Radio Environment, Description of Mobile Radio Transmission Medium, Model of Transmission Medium, Mobile Fading characteristics, The Radius of Active Scatter region, Delay spread and Coherence Bandwidth, Noise level in Cellular Frequency band

UNIT – II

Frequency Reuse Concept and Cellular system Components:

Concept of Frequency reuse channels, Frequency reuse schemes, Frequency reuse distance, Number of Customers in the System, Co-Channel Interference Reduction Factor, Desired C/I from a Normal case in an Omni-directional antenna System, Handoff mechanism, Cell splitting, Consideration of the Components of Cellular Systems, Antennas, Switching equipment and Data Links.

UNIT – III

Cell Coverage:

General Introduction, Ground Incident angle and Ground Elevation angle, Ground Reflection angle and Reflection point, Obtaining the Mobile Point-to-Point Model (Lee Model), A standard condition, Obtain Area-to-Area Prediction model, The Phase difference between a direct path and ground-reflected path, A general formula for Mobile Radio Propagation Propagation over water or Flat open area, Between Fixed stations, Land-to-Mobile transmission over water, Foliage Loss, Propagation in Near-In distance, Long distance propagation, Obtain Path loss from a Point-to-Point Prediction Model in Non-obstuctive condition and obstructive condition, Form of a Point-to-Point Model, General Formula and its Merit

UNIT – IV

Cell-Site and Mobile Antennas:

Antennas at Cell-site, Omnidirectional antennas, Directional antennas, Location antennas, Set-up Channel antennas, Space Diversity Antennas at cell site, Umbrella-Pattern Antennas, Interference reduction antennas, Unique Situations of Cell-Site antennas, Smart antennas, types and applications
Mobile Antennas, Roof-mounted antenna, Glass-Mounted antenna, High-gain antenna, horizontally and vertically oriented Space-Diversity Antennas.

UNIT – V

Handoff and Dropped Calls:

Value of Implementing Handoffs, Types of Handoff, Initiation of Hard Handoff, Delaying a Handoff, Forced Handoffs. Queuing of handoffs, Power difference Handoffs, MAHO and Soft Handoff, Cell-site Handoff only, Intersystem Handoff
Introduction to Dropped Call Rate and Formula of Dropped Call Rate

Suggested Readings:

1. William C.Y.Lee, *"Wireless and Cellular Telecommunications*", 3rd International edition, McGraw Hill, 2006.

2. Theodere S. Rappaport, *"Wireless Communications, Principles and Practice*", 2nd edition, Prentice Hall, 2003.

3. Gordon L. Stuber. "*Principles of Mobile Communications",* 3rd edition, Springer Publications, 2011.

OE 804EC

INTERNET OF THINGS AND APPLICATIONS

(OPEN ELECTIVE - III)

Instruction: (3L) hours per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives:

- To introduce the concepts of automation in daily life.
- To familiarize the concepts of all IoT based communication systems.
- To understand the importance of cloud technologies in the field of IoT.
- To get familiar with standard embedded boards like Raspberry Pi.
- To study a real time system with a view of an application program interface (API).

Course Outcomes: Student will be

1. Able to design IoT based solutions for given problem statements.
2. Able to develop programs for Raspberry Pi.
3. Able to demonstrate the functionality of cloud communication.
4. Able to analyze the technologies used in IoT.
5. Able to incorporate multiple sensors to develop an IoT based system.

UNIT- I

Introduction to Internet of Things

Definition and Characteristics of IoT, Physical Design of IoT: Things in IoT,IoT protocols, Logical Design of IoT: IoT functional Blocks, Communication Models, APIs, IoT enabling TEchnologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics IoT Applications: Smart Home, Smart Cities, Smart Environment, Smart Energy, Smart Retail and Logistics, Smart Agriculture and Industry, Smart Industry and smart Health (Ref1)

UNIT- II

Internet Principles and communication technology

Internet Communications: An Overview – IP, TCP, IP protocol Suite, UDP. IP addresses – DNS, Static and Dynamic IP addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols – HTTP, HTTPS, Cost Vs Ease of Production, Prototypes and Production, Open Source Vs Closed Source. Prototyping Embedded Devices – Sensors, Actuators, Microcontrollers, SoC, Choosing a platform, Prototyping Hardware platforms – Arduino, Raspberry Pi. Prototyping the physical design – Laser Cutting, 3D printing, CNC Milling.

UNIT- III

API Development and Embedded Programming

Getting started with API, Writing a new API, Real time Reactions, Other Protocols, Techniques for writing embedded code: Memory management, Performance and Battery Life, Libraries, Debugging. Developing Internet of Things: IoT design Methodology, Case study on IoT System for weather Monitoring.

UNIT -IV

IoT Systems - Logical Design using Python

Introduction to Python, Data Types and Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/Time Operations, Classes, and Python packages for IoT, IoT Physical Devices and Endpoints: Raspberry Pi, Interfaces of Pi, Programming pi with Python - Controlling LED and LDR using Pi with python programming.

UNIT- V

Cloud computing and Data analytics and IoT Product Manufacturing

Introduction to Cloud storage models and Communication APIs, Amazon web services for IoT, Sky net IoT Messaging Platform. Introduction to Data Analytics for IoT (Ref 1). Case studies illustrating IoT Design – Smart Lighting, Weather Monitoring, Smart Irrigation.(Ref 1) Business model for IoT product manufacturing, IoT Startups, Mass manufacturing, Ethical issues in IoT.

Suggested Readings:

1. Vijay Madisetti , ArshdeepBahga, "*Internet of Things (A Hands-on-Approach)",* VPT Publisher, 1st Edition, 2014

2. Adrian McEwen (Author), Hakim Cassimally", *"Designing the Internet of Things",* Wiley India Publishers

3. Kenneth A Lambert and B.L. Juneja*, "Fundamentals of Python*", Cenage Learning

OE 805EC

GLOBAL AND REGIONAL SATELLITE NAVIGATION SYSTEM

(OPEN ELECTIVE - III)

Instruction: (3L) hours per week — Duration of SEE: 3 hours
CIE: 30 marks — SEE: 70 marks
Credits: 3

Course Objectives:

- To explain the basic principle of GPS and its operation.
- To make the students to understand signal structure.
- To make the students understand the GPS errors.
- Highlight the importance of integrating GPS with other systems.
- To make the students understand about various GRNSS.

Course Outcomes: Student will be

1. Able to understand the principle and operation of GPS.
2. Able to understand the GPS Signal structure and services.
3. Able to understand about various errors.
4. Able to use of GPS in various fields such as navigation, GIS etc.
5. Able to understand principle of Operation of various GRNSS.

UNIT- I

Introduction to Satellites, their properties, Orbits and Launch vehicles, Kepler's Laws, GPS fundamentals: Principle of Trilaiteration, Transit, GPS Operating Principle, And Architecture: Space, Control and User Segments and its Frequencies.

UNIT- II

GPS Signal structure: C/A and P-Codes, SPS and PPS services, GPS Coordinate Systems: Significance, Types of GPS receivers, Selective Availability, Spoofing and Anti-spoofing.

UNIT- III

GPS Errors: Ionospheric error, Tropospheric error, Ephemeris error, Clock errors, Satellite and receiver instrumental biases, Multipath; Dilution of Precision (DOP).

UNIT- IV

GPS Modernization: Future GPS satellites, New signals and their benefits, New Control Segment, Principle of operation of DGPS, architecture and limitations, GPS Applications: Surveying Mapping Marine, air and land Navigation, Military and Space Application. GPS Integration with Geographic Information System (GIS), Inertial Navigation System (INS), Pseudolite and Cellular.

UNIT- V

Other GRNSS: GLONASS, GALILEO, QZNSS, CNSS and IRNSS System: Principle of Operation, Features and their Current Status.

Suggested Readings:

1. Ahmed El-Rabbany, "Introduction to GPS", Artech House Publishers, 2/e, Boston 2006.

2. Elliot D Kaplan and Christopher J Hegarty," Understanding GPS principles and applications", Artech House Publishers, 2/e Boston & London 2005.

3. B.Hofmann-Wellenhof, H.Lichtenegger, and J.Collins, "GPS Theory and Practice," Springer Verlog, 5/e, 2008.

OE806EE

APPLICATIONS OF ELECTRICAL ENERGY

(OPEN ELECTIVE-III)

Instruction: 3 Periods per week
CIE: 30 Marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 Marks

Course Objectives

- To introduce the students and understand Utilization of electrical energy for various applications like industrial heating.
- To understand various techniques of electric welding and types of batteries.
- To understand the concept of illumination, and know the applications of various lamps to factory lighting, street lighting etc.
- To understand the concept of electric traction including speed – time curves of different traction services.
- To understand systems of train lighting.

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

1. Identify a suitable heating scheme for a given application.
2. Identify proper welding technique and various characteristics of batteries.
3. Classify types of electric light sources based on nature and operation and their objectives, performance and reliability.
4. Determine the speed-time characteristics of various traction services and also estimate the energy consumption levels at various modes of operation.
5. Select proper train lighting scheme.

UNIT-I

Industrial Heating: Advantages and methods of electric heating. Description, operation and performance of resistance ovens, Design of heating element. High frequency heating, Induction Heating, Induction furnaces, Core type, Coreless furnaces, Dielectric heating. Electric Arc furnaces, Direct Arc furnace, Indirect Arc furnaces.

UNIT- II

Electric welding: Classification of Electric welding, welding transformer and its rating, various types of Electric arc welding and electric resistance welding.

Batteries: Lead acid batteries, SMF batteries, Construction and maintenance, Charging and rating of batteries.

UNIT- III

Illumination: Introduction, nature and production of light, Sensitivity of the eye, Units of light. The inverse square law and cosine law, Solid angle, Lighting calculations, Determination of M.S.C.P, Rousseau's construction, Discharge lamps, Sodium vapour lamps, Mercury vapourlamps,Fluorescent lamp, Starting and power factor corrections, Stroboscopic effects, Neon signs, Application to factory lighting, Street lighting and Flood lighting.

UNIT- IV

Electric Traction: System of Electric Traction, Transmission of drive, Systems of track electrification, Traction mechanics, Speed time curves, Tractive effort, Power of Traction motor, Specific energy consumption, Mechanics of train movement, Coefficient of adhesion.

UNIT – V

Train Lighting: Systems of train lighting, special requirements of train lighting, Methods of obtaining unidirectional polarity, Methods of obtaining constant output, Single battery system, Double battery parallel block system, Principal equipment of double battery system, Coach wiring, Dynamo.

Suggested Reading:

1. Partab H, Art and Science of Utilization of Electric Power, Dhanpat Rai & Sons, 1997.
2. K.B. Raina & S.K. Bhattacharya, Electrical Design, Estimating 1. and Costing, Wiley Eastern Ltd., 1991.
3. Partab H, Modern Electric Traction, Dhanpat Rai & Sons, 2000.
4. B.L.Theraja, A Text Book of Electrical Technology, S.Chand& Company Ltd, Vol-I.

OE 807ME

COMPOSITE MATERIAL APPLICATIONS

(OPEN ELECTIVE - III)

Instruction: (3L) hours per week
Duration of SEE: 3 hours
CIE: 30 marks
SEE: 70 marks
Credits: 3

Course Objectives:

- To know the properties of fiber and matrix materials used in composites, as well as some common manufacturing techniques.
- To know the various moulding process and architecture of composite laminates
- To know how to estimate the laminate properties from lamina properties.
- To understand the strength of an orthotropic lamina and measurement of basic composite properties.

Course Outcomes: Student will be able to

1. Understand the distinction of composites, its advantages, classification and applications
2. Predict the properties of composite lamina and laminate
3. Understand the testing of composites and design the structure using the appropriate design criteria.

UNIT- I

Introduction to composite materials, general characteristics, Fibres, Matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon fibre composites.

UNIT- II

Molding Processes: hand layup, vacuum molding, compression molding, pultrusion molding, centrifugal molding, filament winding, prepegs and molding compounds and architecture of composite materials: laminates, sandwich composites and other architectures.

UNIT- III

Micromechanics of Composites: Mechanical properties: Production of Elastic constant, micromechanical approach, Halpin-Tsal equations, Transverse stresses. Thermal properties: Hygrothermal stresses, mechanics of load transfer from matrix to fibre.

UNIT- IV

Macromechanics of Composites: Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation.

UNIT- V

Strength of an orthotropic lamina: Maximum stress theory, maximum strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria. Designing with composite materials. Measurement of constituent material properties: Fibre tests, Matrix tests. Measurement of basic composite properties: Tensile test, compressive test, a plane shear test, interlaminar shear test, flexure test.

Suggested Readings:

1. Jones, R.M., *"Mechanics of Composite Materials"*, McGraw Hill Co., 1967.
2. Ronald F. Gibson, "*Principles of Composite Materials Mechanics*", McGraw-Hill, Inc.,1994.
3. Krishan, K. Chewla, "*Composite Material*", Springer - verlag, 1987.
4. Carl. T. Herakovich, *"Mechanics of Fibrous Composites*", John Wiley Sons Inc., 1998.

OE808ME

INDUSTRIAL ADMINISTRATION AND FINANCIAL MANAGEMENT

(OPEN ELECTIVE - III)

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- To understand various types of organizational structures, manufacturing processes and importance of
- plant layout and the role of scheduling function in optimizing the utilization of resources
- To understand the importance of quality, inventory control and concepts like MRP I and MRP II
- To understand the nature of financial management and concepts like breakeven analysis, depreciation and replacement analysis

Course Outcomes:

1. At the end of this course student is expected reach the following outcomes.
2. Understand the different phases of product life cycle, types of manufacturing systems, plant layout optimization problems
3. Role of scheduling function in better utilization of resources
4. Fundamental concepts of quality control, process control, material control and appreciate the importance of MRP-I and MRP –II.
5. Know the different terminology used in financial management and apply different techniques of capital budgeting
6. Analyse and various types of costs involved in running an industrial organization

UNIT-I

Types of organizations, organizational structures. Designing Products, Services and Processes: New product design and development. Product life cycle: phasing multiple products.
Manufacturing process Technology: Product, job shop, batch, assembly line and continuous process technology; flexible manufacturing systems. Design of Services, service process technology operations capacity; capacity planning decisions, measuring capacity; estimating future capacity needs.

UNIT-II

Locating production and services facilities, effects of location and costs and revenues, factor rating, simple median model (linear programming) Layout planning; process layout; product layout - Assembly lines; line balancing manufacturing cellular layout. Scheduling systems and aggregate planning for production and services; loading assignment algorithm; priority sequencing and other criteria.

UNIT-III

Quality planning and Control: basic concepts, definitions and history of quality control. Quality function and concept of quality cycle. Quality policy and objectives. Economics of quality and

measurement of the cost of quality. Quality considerations in design. Process control: machine and process capability analysis. Use of control charts and process engineering techniques for implementing the quality plan. Acceptance sampling: single, double and multiple sampling, operating characteristic Curve - calculation of producers risk and consumers risk.

UNIT-IV

Inventory control: deterministic and stochastic inventory models; variable demand; lead time, specific service level, perishable products and service. Inventory control in application; concepts for the practioners; saving money in inventory systems; ABC classifications. Inventory control procedures; Quantity - reorders versus periodic inventory systems; material requirement planning (MRP); MRP as a scheduling and ordering system; MRP system components; MRP computational procedure; Detailed capacity planning; MRP - limitation and advantages; Manufacturing Resources Planning (MRP-II).

UNIT-V

Elements of cost, overheads, breakeven analysis, depreciation, replacement analysis. Nature of financial management-time value of money, techniques of capital budgeting and method, cost of capital, financial leverage.

Suggested Reading:

1. Buifa and Sarin, "Production and operations management" - Wiley Publications.

2. I.M. Pandey, "Elements of Financial Management" Vikas Publications, New Delhi, 1994.

3. James C. Van Home & John, M. Wachowicz, Jr., "Fundamentals of Financial Management", Pearson Education Asia, 11 Th ed. 2001.

OE809CS

SOFTWARE ENGINEERING

(OPEN ELECTIVE - III)

Instruction: 3 Periods per week
Duration of SEE: 3 hours
CIE: 30 Marks
SEE: 70 Marks
Credits: 3

Course Objectives:

- To introduce the basic concepts of software development- processes from defining a product to shipping and maintaining that product.
- To impart knowledge on various phases, methodologies and practices of software development.
- To understand the importance of testing in software development and study various testing strategies and software quality metrics.

Course Outcomes: Student will be able to

1. Acquire working knowledge of alternative approaches and techniques for each phase of software development
2. Acquire skills necessary for independently developing a complete software project
3. Understand the practical challenges associated with the development of a significant software system

UNIT-I

Introduction to Software Engineering:
A generic view of Process: Software Engineering, Process Framework, CMM Process Patterns, Process Assessment.

Process Models: Prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.
An Agile view of Process: Introduction to Agility and Agile Process, Agile Process Models.

UNIT-II

Software Engineering Principles: SE Principles, Communication Principles, Planning Principles, Modeling Principles, Construction Principles, Deployment.
System Engineering: Computer-based Systems, The System Engineering Hierarchy, Business Process Engineering, Product Engineering, System Modeling.
Requirements Engineering: A Bridge to Design and Construction, Requirements Engineering Tasks, Initiating Requirements Engineering Process, Eliciting Requirements, Developing Use-Cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements.

UNIT-III

Building the Analysis Model: Requirements Analysis Modeling Approaches, Data Modeling Concepts, Object-Oriented Analysis, Scenario-based Modeling, Flow-oriented Modeling, Class-based Modeling, Creating a Behavioral Model.

Design Engineering: Design within the context of SE, Design Process and Design Quality, Design Concepts, The Design Model, Pattern-based Software Design.

UNIT-IV

Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design, Assessing Alternative Architectural Designs, Mapping Data Flow into a Software Architecture.

Modeling Component-Level Design: Definition of Component, Designing Class-based Components, Conducting Component-level Design, Object Constraint Language, Designing Conventional Components.

Performing User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT-V

Software Quality Assurance: Basic Elements, Tasks, Goals and Metrics, Formal Approaches, Statistical Software Quality Assurance, Software Reliability, ISO 9000 Quality Standards, SQA Plan.

Testing Strategies: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for O-O Software, Validation Testing, System Testing, The Art of Debugging.

Testing Tactics: Software Testing Fundamentals, Black-box and White-box Testing, Basis Path Testing, Control Structure Testing, O-O Testing Methods, Testing Methods applicable on the Class Level, Inter Class Test Case Design, Testing for Specialized Environments, Architectures and Applications, Testing Patterns.

Product Metrics: Software Quality, A Framework for Product Metrics, Metrics for the Analysis Model, Metrics for the Design Model, Metrics for Source Code, Metrics for Testing, Metrics for Maintenance.

Suggested Readings:

1. Roger S.Pressman," *Software Enigneering: A Practitioner's Approach*", 7th Edition, McGraw Hill, 2009.
2. Ali Behforooz and Frederick J.Hudson, "*Software Engineering Fundamentals*", Oxford University Press, 1996.
3. Pankaj Jalote, "*An Integrated Approach to Software Engineering*", 3rd Edition, Narosa Publishing House, 2008.

OE810CS

PYTHON PROGRAMMING

(OPEN ELECTIVE - III)

Instruction: 3 Periods per week
Duration of SEE: 3 hours
CIE: 30 Marks
SEE: 70 Marks
Credits: 3

Course Objectives:

The main objective is to teach Computational thinking using Python.

- To know the basics of Programming
- To convert an algorithm into a Python program
- To construct Python programs with control structures.
- To structure a Python Program as a set of functions
- To use Python data structures-lists, tuples, dictionaries.
- To do input/output with files in Python.
- To construct Python programs as a set of objects.

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

1. Develop algorithmic solutions to simple computational problems.
2. Develop and execute simple Python programs.
3. Develop simple Python programs for solving problems.
4. Structure a Python program into functions.
5. Represent compound data using Python lists, tuples, dictionaries.
6. Read and write data from/to files in Python Programs

UNIT-I

Introduction to Computing and Problem Solving: Fundamentals of Computing – Computing Devices – Identification of Computational Problems – Pseudo Code and Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms.

Introduction to Python Programming: Python Interpreter and Interactive Mode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements, Reading Input, Print Output, Type Conversions, The type() Function and Is Operator, Dynamic and Strongly Typed Language.

Control Flow Statements: The if, The if…else,The if…elif…else Decision Control Statements, Nested if Statement, The while Loop, The for Loop, The continue and break Statements.

UNIT-II

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, Command Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT-III

Files and Exception: Text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

Strings: Basic String Operations, String Slicing, Testing, Searching, and Manipulating Strings

Dictionaries and Sets: Dictionaries, Sets, Serializing Objects.

UNIT-IV

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance The Polymorphism.

Functional Programming: Lambda. Iterators, Generators, List Comprehensions.

UNIT-V

GUI Programming: Graphical User Interfaces, Using the tkinter Module, Display text with Label Widgets, Organizing Widgets with Frames, Button Widgets and Info Dialog Boxes, Getting Input with Entry Widget, Using Labels as Output Fields, Radio Buttons, Check Buttons.

Suggested Readings:

1. Richard L. Halterman, "*Learning To Program With Python*", Copyright © 2011.
2. Dr. Charles R, "*Python for Everybody, Exploring Data Using Python 3*", Severance. 2016.
3. Gowrishankar S., Veena A, "*Introduction to Python Programming*", CRC Press, Taylor & Francis Group, 2019.
4. Allen B. Downey, "*Think Python: How to Think Like a Computer Scientist*'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)

OE811CS

CYBER SECURITY

(OPEN ELECTIVE - III)

Instruction: 3 Periods per week
CIE: 30 Marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 Marks

Course Objectives:

- Understand the threats in networks and security concepts.
- Apply authentication applications in different networks.
- Understand security services for email.
- Awareness of firewall and it applications.

Course Outcomes:

After Completion of the course, Student will be able to:

1. Understand the various network threats
2. Analyse 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.

PW851 BM

MAJOR PROJECT PHASE - II / INDUSTRIAL INTERNSHIP

Instruction	12 Periods per week
CEE	50 Marks
SEE	100 Marks
Credits	6

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. Conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
4. Work in a research environment or in an industrial environment.
5. 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.