SCHEME OF INSTRUCTION

B.E. (Biomedical Engineering)

VII - SEMESTER

With effect from the Academic year 2018-2019

S. No	Course Code	Course Title	Scheme of Examination		L	T	P	Hrs/ Wk	Credits
			CIE	SEE					
1.	PC701BM	Biomedical Equipment II	30	70	3	0	0	3	3
2.	PC702BM	Biomedical Signal Processing	30	70	3	0	0	3	3
3.	PC703BM	Medical Image Processing	30	70	3	1	0	4	3
4.	PC704BM	Biomechanics	30	70	3	0	0	3	3
5.	PE-III*	Professional Elective-III	30	70	3	0	0	3	3
6.	PE-IV*	Professional Elective-IV	30	70	3	0	0	3	3
7.	OE-II*	Open Elective-II	30	70	3	0	0	3	3
PRACTICALS									
8.	PC751BM	Biosignal & Image processing Lab	25	50	0	0	3	3	1
9.	PW761BM	Project Work-I	50	--	0	0	0	2	4
10.	PW961BM	Summer Internship**	50	--				-	2
11.	MC951SP MC952NS MC953SP	Yoga Practice/ NSS/ Sports	30	70	3	0	0	3	3 Units
Total			**365**	**610**	**24**	**01**	**03**	**30**	**28**

**Industry Attachment Program – Duration – 8 Weeks during summer vacation

Professional Elective-III		Professional Elective–IV	
PE701BM	Cell and Tissue Engineering	PE703BM	Fiber Optics & Lasers In Medicine
PE702BM	Product design and development	PE704BM	Rehabilitation Engineering

OE-II* # Open Elective-II:

*OE701BM Human Factor Engineering & Ergonomics
*OE702BM Basic Medical Equipment
OE701CE Optimization Techniques
OE701CS Database Systems
OE702CS Information Security
OE701EC Principles of electronic communications
OE702EC Fundamentals of IOT
OE701EE Non Conventional Energy Sources
OE701ME Startup Entrepreneurship
OE702ME Finite Element Methods

***OE701BM & *OE702BM Electives offered only for CE/CS/EC/EE/ME**

With effect from the academic year 2018-2019

Professional Elective-V: List of NPTEL courses as approved by Department of BME

Open Elective-III: List of NPTEL courses as approved by Department of BME

Url link address of the courses https://onlinecourses.nptel.ac.in

Note: Students can register for the courses online and obtain the certificate from NPTEL

NOTE:

1. **Students who are planning to go and also selected students for full semester INTERNSHIP during their 8th semester will have to complete the course requirement through online SWAYAM/ MOOC/ NPTEL courses with relevant examinations based on the guidelines stipulated by College.**
2. **The credits for all the NPTEL courses will be credited for the successful students only during the VIII semester by the Examination Cell, UCE (A), O.U.**
3. **The Professional Electives, Open Electives and Project work will be offered to regular students. The selected students for full VIII Semester (16 weeks) internship will undertake internship based on the guidelines stipulated by College and submit a report to the Department of their Internship in place of Project work – II of VIII semester.**
4. **All other students will be taking the Professional Electives or Open Electives along with Project work – II of VIII semester.**

With effect from the academic year 2018-2019

PC701 BM

BIO-MEDICAL EQUIPMENT-II

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- To familiarize the latest technologies of modern medicine
- To make learners able to use new and updated diagnostic methodologies
- To provide knowledge of the principle of operation and design of radiological equipment
- To understand the need and use of extracorporeal devices, and the use of lasers in medicine.
- To enable the students to gain knowledge on the working of surgical equipment.

Course Outcomes: Successfully the student will be able to:

1. to interpret the safe operating procedure of all medical equipments
2. understanding the functionality of equipment used in surgery, physiotherapy and ophthalmology
3. to summarize the operation of various medical equipments used in Neonatology, ENT and OT
4. to compare the various techniques analyze various medical imaging techniques
5. examine the applications of lasers in biomedical field

UNIT-I

Hospital power distribution system: Design and layout, power factor improvement, maximum demand, safety, metering, booster transformers, isolators. **Electrical Safety:** physiological effects of electricity, macro-shock and micro-shock hazards, electrical safety codes and standards, electrical safety analyzers, testing the electric systems.

UNIT-II

Electrosurgical Equipment: ESU, principles of cutting and coagulation, spark gap, valve and solid state generators, safety features.**Introduction to Lithotripsy**-Principles and Applications, **Physiotherapy Equipment**-Short Wave, Microwave and Ultrasound Diathermy, **Ophthalmic Instruments**-Intraocular Pressure Measurement Contacting and Non-Contacting Types, Refractometer, Ophthalmoscope, Retinoscope, Keratometer.

UNIT-III

Audiometry: Common tests and procedures, audiometer. **Hearing Aids:** Different types, comparison of microphones receivers and amplifiers, cochlear Implants. **Neonatal instrumentation:** incubators, aproea monitor, photo-therapy devices. **Haemodialyzer:** qualitative requirements, general scheme of operation, types of exchangers, block diagram, electronic control and monitoring. **General anesthesia:** information about medical gases and vacuum systems, anesthesia equipment. Liquid medical –O2 systems, Theatre sterility practices.

UNIT-IV

Imaging Equipment: Ultrasound, computer aided tomography, magnetic resonance imaging, SPECT, PET: Basic Principle of Operation and Applications. Introduction to Radionuclide Instrumentation-Gamma camera, rectilinear scanner, radioisotopes, mobile C-ARM radiotherapy equipment MRI.

UNIT-V

Photonics: Optic fibers: optical fiber waveguides, wave propagation, types of optical fibers, attenuation and dispersion in optical fibers, applications in Endoscopy. **Lasers:** Emission and Absorption in Radiation, Population Inversion and Threshold condition, Laser Losses, Types of Lasers-CO2, Helium-neon, Nd-Y-Ag lasers, Applications in Surgery, Angiography, and Endoscopy.

Suggested reading:

1. Bronzino Joseph D., *Handbook of Biomedical Engineering*, CRC Press, 1995.
2. Khandpur R.S., *Handbook of Biomedical Instrumentation*, Tata McGraw Hill, 1994.
3. John G.Webster, *Medical Instrumentation: Application and Design*,Jhon Wiley and Sons Inc., 3rd Ed., 2003.
4. Cotton H., *Electrical Technology*, AHW & Co., 1983.

PC702 BM

BIOMEDICAL SIGNAL PROCESSING

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- Understand the need for adaptive filters
- Understand the signal processing techniques used for ECG and EEG.
- Understand the wavelet concepts
- Understand the signal processing steps involved in Brain-Computer Interface.

Course Outcomes: Successfully the student will be able to:

1. design and implement digital filters for noise reduction in electrophysiological data
2. to adapt various Signal Processing techniques to identify ECG parameters
3. to assess various Signal Processing techniques for analysis of EEG
4. to apply wavelet analysis to identify different features of biological signals
5. to understand the concept of BCI

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. StephaneMallat, "*Wavelet Tour of Signal Processing*:*The Sparse Way "*, 3rd ed. Academic Press, 2008.

PC703 BM

MEDICAL IMAGE PROCESSING

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- To study the image fundamentals and mathematical transforms necessary for image processing
- To study the image enhancement techniques
- To study image restoration procedures
- To study the image compression procedures

Course Outcomes: Successfully the student will be able to:

1. to give basic knowledge of various image processing methodologies and how the same can be applied to medical images
2. to examine image enhancement techniques
3. to develop the concept of image Restoration pertaining to medical images
4. to evaluate various image segmentation techniques
5. gaining fundamental idea on image representation, description and recognition

UNIT-I

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

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

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

Points 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, 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 BhagavathiCharan Patel, Medical Image Processing concepts and applications,PHI,2014
4.Chanda&Majumdar, Digital image processing and analysis, Second edition PHI, 2013.

PC704 BM

BIOMECHANICS

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- Identify a given bone, ligament or muscle by name, anatomic location, or function.
- The general characteristics, material properties, appropriate constitutive model, and adaptation potential for tissue and organs are studied.
- Analyze the forces at a skeletal joint for various static and dynamic human activities

Course Outcomes: Successfully the student will be able to:

1. outline the mechanical properties of biological tissues and compare them with those of Engineering Materials
2. apply the principles of statics to estimate joint forces
3. develop the pressure flow relationship in blood vessels for the idealized case
4. derive the pressure volume relationship for lung and interprets its Diagnostic significance
5. Identify the process for implant manufacture and choose appropriate biomaterials.

UNIT-I

Properties of biological tissues: Mechanical Properties of collagen, elastin, bone, cartilage, tendons, ligaments, muscles and synovial fluid. Muscle models. Evaluation tests for mechanical properties of biological tissues. Features of viscoelasticity, constitutive equations and uses of viscoelastic models. Bio-viscoelestic solids and fluids.

UNIT-II

Statics in biomechanics: Analysis of rigid bodies in equilibrium, conditions for equilibrium, free body diagrams, General procedure to analyze systems in equilibrium, Types of support or joint with biomechanical examples. Analysis of joints in various postures. Basic assumptions and limitations, Biomechanical analysis of elbow, shoulder, spinal column, hip, knee and ankle.

UNIT-III

Cardiovascular mechanics: Forces involved in blood flow, Generalized Bernoulli's equation, Wind kessel model, Stresses in the ventricular wall, Pressure-Volume loop. Hagen-Poiseuille Law-derivation and applications, steady laminar flow in elastic tube, Wave propagation in blood vessels, Reflection and transmission of waves at arterial junctions, Blood flow in veins, microcirculation.

UNIT-IV:

Pulmonary mechanics: Mechanism of air flow, Respiratory cycle, Lung Ventilation model, Methods of determining pressure, flow-rate and volume-Spirometry, Respiratory plethysmography, Diagnostic significance of the lung-ventilation model, static and dynamic respiratory mechanics tests.

UNIT-V:

Orthopedic implants: Design process of an orthopedic implant, typical specifications for an prosthetic joint, Biocompatibility, Requirements of a biomaterial, Characteristics of different types of biomaterials, manufacturing process of implants, fixation of implants-Mechanical fixation, cements and adhesives, porous materials.

Suggested Reading:

1. Y.C.Fung., *Biomechanics-Mechanical Properties of Living Tissues,* Springer-Verlag,1981.
2. NihatOzkaya and MatgaretaNordin, "*Fundamentals of Biomechanics-Equilibrium, Motion and Deformation*", Sringer-Verlag, 1984
3. Y.C.Fung., *Biodynamics-circulation,* Springer-Verlag,1984.
4. John G. Webster, *Medical Instrumentation-Application and design,* John Wiley and sons Inc., 3rd Ed., 2003
5. D.Dowson and V. Wright, "*AN Introduction to Biomechanics of Joints and Joint Replacements*", Mechanical Engineering Publications, 1980

PE701 BM

CELL AND TISSUE ENGINEERING
(PROFESSIONAL ELECTIVE-III)

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- This course helps to gain deeper knowledge to understanding about the subject cell and tissue engineering.
- The students will learn about the key concepts of cell biology and tissue organization and the technologies used in tissue engineering.

Course Outcomes: Successfully the student will be able to:

1. describe multidisciplinary nature of cell and tissue engineering with examples
2. to pursue Tools and techniques of cell biology
3. to understand the organization of tissues to construct different organs
4. to develop concept of bioreactors and related challenges
5. to compose the knowledge of tumor cells

UNIT-I

Cell structure and organization: Cells as a unit of life, structure and basic functions of various cell organelles. Cell cycle: G1, G2, S and M Phase of the cell cycle. Cell cycle analysis and its applications, programmed cell death apoptosis versus necrosis. Role of telomeres in the cell cycle.

UNIT-II

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

UNIT-III

Organization of tissues: Cell-cell and cell-matrix interactions, cell adhesion molecules, components of the extracellular matrix, cellular junctions, response to mechanical stimuli.

UNIT-IV

Relevance of Cell Biology: Stem cells, Biomaterials and BioreaactorsinTissue engineering, challenges in tissue engineering.

UNIT-V

Cancer: Tumor cells, cell lines and models, proto-oncogenes and oncogenes, oncogenic mutations, loss of cell cycle control, carcinogens.

Suggested reading:

1. Molecular Cell Biology by Harvey Lodish
2. Cell and Molecular Biology, Gerald Karp, John Wiley & Sons, Inc.
3. The molecular and cellular biology of wound repair. Clark, Plenum Press.

PE702 BM

PRODUCT DESIGN AND DEVELOPMENT
(PROFESSIONAL ELECTIVE-III)

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 marks

Course Objectives:

- This course is designed to focus on theory, technologies and practical applications in the product design, development and management over whole product life cycle.

Course Outcomes: Successfully the student will be able to:

1. identify and analyze the product design and development processes in manufacturing industry
2. define the components and their functions of product design and development processes
3. analyze, evaluate and apply the methodologies for product design, development and Management
4. to develop the concept of human factor engineering
5. be familiar with different test methods for biocompatibility

UNIT-I

Introduction to Biomedical Engineering Design: Design, Essential Of Design, Biomedical Engineering Design In An Industrial Context, Generic Steps In The Design And Development Of Products And Processes. Fundamental Design Tools - Brainstorming And Idea Generation Techiniques, Conventional Solution Searches, Function Analysis, Elementary Decision Making Techniques, Objective Trees, Introduction Quality Function Deployment Diagrams, Introduction To TRIZ.

UNIT-II

Product Definition -– Definition of Medical Device, Product Definition Process, Overview Of QFD, QFD Process, Product Development – Product Requirements, Design & Development planning, system Requirements specification, design input&output, design Verification & Validation,Design Transfer.

UNIT-III

Hardware Development Methods And Tools – Six Sigma, Redundancy, Component Selection, Component Derating, Safety Margin, Load Protection, Product Misuse, Extended Triz Design Techniques.

Software Development Methods And Tools - Software Development Planning,- Choosing The Software Development Process Model, Software Design Levels, Design Alternatives And Trade-Offs, Software Arctitecture, Choosing A Methodology, Choosing A Language, Software Rist Analysis ,Requirements Traceability Matrix, Software Review, Design Technique, Performance Predictability And Design Simulation, Module Specifications, Coding Design Support Tools, Design As The Basis For Verification And Validation Activity.

UNIT-IV

Human Factors- Definition of Human Factors,Human Element In Human Factors Engineering,Hardware Element In Human Factors,Software Elemnt In Human Factors,Human Factors Process,Planning, Analysis,Conduct User Studies,Set Usability Goals,Design User Interface Concepts,Model The User Interface,Test The User Interface,Specify The User Interface,Additional Human Factors Design Considerations,Fitts" Law. Industrial Design – Design user interface concepts, specify the user interface, additional industrial design considerations.

UNIT-V

Biomaterials And Material Testing- FDA and biocompatability, IRE, device category and choice of test program, preparation of extracts, biological control tests, tests for biological evaluation, alternative test methods.

Suggested reading:

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

PC703 BM

FIBER OPTICS & LASERS IN MEDICINE
(PROFESSIONAL ELECTIVE-IV)

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 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. to introduce the basics of lasers
2. analyze the optical properties and light interactions with tissues
3. understand the basic concepts of optical fibres and their properties
4. to inculcate the principles of endoscopy using Optical Fibre bundles
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-photothermal & 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 fiberoptic bundles for imaging devices-fundamentals & principles, fiberoscopes and endoscopes-fundamentals fiber optic imaging systems-advances.
Endoscopy: Introduction endoscopic imaging systems-fundamental, principles, advances, endoscopic diagnostic –advances endiscopic therapy –fundamentals.

UNIT-V

Clinical Applications Of Fiber Optic Laser Systems: Introduction ,fiber optic laser system in cardiovascular disease, gastroenterology. Gynecology, neurosurgery, oncology, ophthalmology, orthopaedics, 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.

PC704 BM

REHABILITATION ENGINEERING
(PROFESSIONAL ELECTIVE-IV)

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 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. to develop the design concept of assistive Technology for personal transportation
3. apply analytical skills to assess and evaluate the need of end user
4. to interpret knowledge of FES in orthotics and prosthetics
5. to examine applications of computer for rehabilitation engineering

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, HisaichiOhnabe, 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, 3rdEd., CRC Press, Taylor & Francis Group, London, 2006.

OE701 BM

HUMAN FACTOR ENGINEERING & ERGONOMICS
(OPEN ELECTIVE-II)

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- Provide a broad based introduction to ergonomic principles and their application in the design of work, equipment and the workplace.
- Consideration is given to musculo-skeletal disorders, manual handling, ergonomic aspects of the environment as well as to the social and legal aspects.

Course Outcomes: Successfully the student will be able to:

1. apply ergonomic principles to the creation of safer, healthier and more efficient and effective activities in the workplace
2. conduct ergonomic risk assessments
3. develop appropriate control measures for ergonomic risk factors
4. describe work-related causes of musculo-skeletal disorders
5. design a workplace according to good ergonomic principles
6. Assess ergonomic aspects of the working environment and work organization.

UNIT-I

General Principles -Aims, objectives and benefits of ergonomics , Definition and scope of ergonomics and systems of work , The role of the ergonomist , Fitting the job to the person and the person to the job , Human characteristics, capabilities and limitations , Human error , Teamwork and ageing , Interfaces between job, person and environment , Human computer interaction

Biological Ergonomics- Body systems - musculo-skeletal and nervous , Anatomy, static and dynamic anthropometry . Biomechanics . Applying work physiology - body metabolism, work capacity and fatigue, Static and dynamic postures

Psychology-Perception of risk , Motivation and behaviour , Memory , Signal Detection Theory and vigilance , ‘Work 'Stress' - causes, preventative and protective measures , Work organisation - shift working and overtime

Developing an Ergonomics Strategy at Work- Culture of an organisation - commitment and decision-making , ‘Macro-ergonomics' and participatory ergonomic teams , Ergonomics at the design stage , Developing ergonomics, professional ergonomists and competence

UNIT-II

Work Design -Task analysis and allocation of functions , User trials , Problem solving - scientific method

Ergonomics Risk Assessment- Definitions of hazard and risk , Priorities , Risk evaluation quantity and quality of risk , Assessment systems , Overall ergonomics approach , Control measures monitoring and feedback

Measurements and Information Gathering-Ergonomics standards , Observational techniques , Rating scales, questionnaires and check lists , Use of models and simulation

UNIT-III

Manual Handling-The nature and causes of manual handling disorders , Risk assessment , Job design and training , Principles of handling and preventative and protective measures

Work Related Upper Limb Disorders (WRULD)- The nature and causes of WRULD/ 'Repetitive Strain Injuries'/Cumulative Disorders , Risk assessment , Principles of control, preventive and protective measures

UNIT-IV

Workplace Layout and Equipment Design- Principles of workstation and system design , Space and workstation design principles , Risks to health: Musculoskeletal problems, Visual fatigue, Mental stress,

Requirements for eye tests, Design considerations for Visual Display Unit (VDU) Stations: Ergonomic factors, Work stations, Design of work and practice, Carrying out assessments of risk at VDU workstations
Controls, Displays and Information-Visual, auditory and other displays , Quantitative and qualitative information , Compatibility and population stereotypes , Warnings, signs and labels , Sources and selection of data , Principles of software ergonomics

UNIT-V
Lighting - Visual acuity and colour vision , Lighting levels, contrast and glare , Reflections and flicker fusion
Noise - Noise induced hearing loss , Distraction, annoyance and emergency signals
Thermal Environment- Body temperature regulation and acclimatisation ,Subjective assessments - thermal comfort and discomfort
Other Considerations- Smell, taste and tactile senses , Vibration - effects and subjective assessment
Clothing and Protective Equipment- Objective and subjective effects , Risk perception, and wearability , Design, style and fit
Standards - ISO standards , Sources of other standards
Selection and Training- Training Needs Analysis , Testing and interview techniques
Instruction and Supervision- Health information, legal requirements , Supervision and records , Measuring health and illness

Suggested Reading:
1. Introduction to Human factors and Ergonomics, 4th edition by Gariel Salvendy, John & Willey & Son's.
2. Introduction to Human Factors and Ergonomics, 4th Edition by Robert Bridger, CRC Press.
3. An Introduction to Human factors Engineering by 2nd Edition, Christopher D. Wickens, Sallie E. Gardon, Yili Liv, PHI series.
4. Stephen Konz and Steve Johnson 2007 Work Design: Occupational Ergonomics 7th Edition Holcomb Hathway.
5. Dul & Weerdmeester 2003 Ergonomics for Beginners Taylor & Francis.
6. R.S.Bridger 2003 Introduction to Ergonomics Taylor & Francis

OE702 BM

BASIC MEDICAL EQUIPMENT
(OPEN ELECTIVE-II)

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- Describe the theory of operation, functioning and clinical application of medical devices such as Medical Monitoring and recording equipments, Physiotherapy and Electrotherapy Equipment, Medical Imaging Equipment, Critical care Equipment, Therapeutic EquipmentS and carry out operational checks on such devices.

Course Outcomes: Successfully the student will be able to:

1. operate the various medical equipment.
2. calibrate and assist in equipment maintenance
3. provide on and off- site assistance with the functioning of the medical equipments.
4. perform as a member of multidisciplinary team in a hospital setting.

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, data recording, replay and analysis, Telemetry.

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 701 CE

OPTIMIZATION TECHNIQUES

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

UNIT-I

Introduction to Classical Optimization Techniques: Statement of optimization problem, Objective function, Classification of optimization problems. Classical Optimization Techniques: Single-variable a multi-variable optimization without constraints. Multi-variable optimization with equality constraints. Lagrange multiplier method, Multi-variable optimization with inequality constraints, Kuhn-Tucker conditions.

UNIT-II

Linear Programming: Standard form, Formulation of the LPP, Solution of simultaneous equations by pivotal condensation, Graphical methods, Simplex algorithm, Big M method, Two phase Simplex method, Duality principle, Dual simplex method.

UNIT-III

Non-linear Programming: One-dimensional search methods. Fibonacci method, Golden section method. Direct Search Method: Univariate search and pattern search methods, Powell's method.

UNIT-IV

Gradient Method: Steepest descent, conjugate gradient and Quasi-Newton methods, Fletcher-Reeves method of conjugate gradients.

UNIT-V

Dynamic Programming: Multistage design process, Types, Principle of optimality, Computational procedure in dynamic programming, Examples using calculus method and tabular method of solutions.

Suggested Reading:

1. S. S.Rao, "Optimization Theory and Application", New Age International, 3rd Edition, 1998.
2. Jasbir S.Arora, "Introduction to Optimum Design", McGraw Hill International Edition, 1989.
3. S.D.Sharma, "Operational Research", Kedamath Ramnath & Co., 2004.

With effect from the academic year 2018-2019

OE 701 CS

DATABASE SYSTEMS

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 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, and recovery

Course Outcomes : Student will be able to:

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 and First 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, Implementation of 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 International Edition, 3rd Edition, 2003
3. Elmasri, Navathe, Somayajulu, Fundamentals of Database Systems, Pearson Education, 4th Edition, 2004

OE 702 CS

INFORMATION SECURITY

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 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: The student should be able to:

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 and accreditation

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, Risk Control Strategies, Selecting a Risk Control Strategy, Quantitative versus Qualitative Risk Control Practices, Risk Management discussion Points, 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, 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 Digital Forensics.

Suggested Reading:

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 701 EC

PRINCIPLES OF ELECTRONIC COMMUNICATIONS

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- Provide an introduction to fundamental concepts in the understanding of communications systems.
- Provide an introduction to network model and some of the network layers including physical layer, data link layer, network layer and transport layer.
- Provide an introduction to the evolution of wireless systems and current wireless technologies.

Course Outcomes: Student will be Able to

1. Understand the working of analog and digital communication systems
2. Understand the OSI network model and the working of data transmission
3. Understand the evolution of communication technologies from traditional telephony systems to modern wireless communication systems.

UNIT- I

Introduction to communication systems: Electromagnetic Frequency Spectrum, Signal and its representation, Elements of Electronic Communications System, Types of Communication Channels, **Signal Transmission Concepts**-Baseband transmission and Broadband transmission, **Communication parameters**-Transmitted power, Channel bandwidth and Noise, Need for modulation **Signal Radiation and Propagation**-Principle of electromagnetic radiation, Types of Antennas, Antenna Parameters and Mechanisms of Propagation.

UNIT- II

Analog and Digital Communications: Amplitude modulation and demodulation, FM modulation and demodulation, Digital converters, Digital modulation schemes – ASK, FSK, PSK, QPSK, Digital demodulation.

UNIT- III

Data Communication and Networking: Network Models, OSI Model, Data Link Layer – Media Access control, Ethernet , Network Layer – Internet Protocol (IPv4/IPv6), Transport Layer – TCP, UDP.

UNIT- IV

Telecommunication Systems: Telephones, Telephone system, Paging systems, Internet Telephony.

Optical Communications: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT- V

Wireless Communications: Evolution of Wireless Systems: AMPS, GSM, CDMA, WCDMA, OFDM. Current Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

Suggested Readings:

1. Principles of Electronic Communication Systems, Louis E. Frenzel, 3e, McGraw Hill publications, 2008.
2. Data Communications and Networking, Behrouz A. Forouzan, 5e TMH, 2012.
3. Kennady, Davis, Electronic Communications systems, 4e, TMH, 1999.

PE 702 EC

Fundamentals of IOT

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- Discuss fundamentals of IoT and its applications and requisite infrastructure
- Describe Internet principles and communication technologies relevant to IoT
- Discuss hardware and software aspects of designing an IoT system
- Describe concepts of cloud computing and Data Analytics
- Discuss business models and manufacturing strategies of IoT products

Course Outcomes: Student will be able to

1. Understand the various applications of IoT and other enabling technologies.
2. Comprehend various protocols and communication technologies used in IoT
3. Design simple IoT systems with requisite hardware and C programming software
4. Understand the relevance of cloud computing and data analytics to IoT
5. Comprehend the business model of IoT from developing a prototype to launching a product.

UNIT- I

Introduction to Internet of Things IOT vision, Strategic research and innnovation directions, Iot Applications, Related future technologies, Infrastructure, Networks and communications, Processes, Data Management, Security, Device level energy issues.

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 Addressess, TCP and UDP Ports, Application Layer Protocols – HTTP,HTTPS, Cost Vs Ease of Production, Prototypes and Production, Open Source Vs Closed Source.

UNIT- III

Prototyping and programming for IoT 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.

Techniques for writing embedded C code: Integer data types in C, Manipulating bits - AND,OR,XOR,NOT, Reading and writing from I/ O ports. Simple Embedded C programs for LED Blinking, Control of motor using switch and temperature sensor for arduino board.

UNIT- IV

Cloud computing and Data analytics Introduction to Cloud storage models -SAAS, PAAS, IAAS. Communication APIs, Amazon webservices for IoT, Skynet IoT Messaging Platform.

Introduction to Data Analytics for IoT - Apache hadoop- Map reduce job execution workflow.

UNIT- V

IoT Product Manufacturing - From prototype to reality Business model for IoT product manufacturing, Business models canvas, Funding an IoT Startup, Mass manufacturing - designing kits, designing PCB,3D

printing, certification, Scaling up software, Ethical issues in IoT- Privacy, Control, Environment, solutions to ethical issues.

Suggested Readings:

1. Internet of Things - Converging Technologies for smart environments and Integrated ecosystems, River Publishers.
2. Designing the Internet of Things , Adrian McEwen, Hakim Cassimally. Wiley India Publishers
3. Fundamentals of embedded software: where C meets assembly by Daneil W lewies, Pearson.
4. Internet of things -A hands on Approach, Arshdeep Bahga, Universities press.

OE 701 EE

NON CONVENTIONAL ENERGY SOURCES

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

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 H2 °2 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 WindBasic 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 Readings:

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.

OE701ME

STARTUP ENTREPRENEURSHIP
(Open Elective-II)

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 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 into reality.
- To understand action driven business plan and learn to prepare project budget.

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

- Think creatively and and transform ideas into reality.
- Differentiate market transforming strategy.
- 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 the business 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 Take Action; 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 Hill Edition, 2002

OE702ME

FINITE ELEMENT METHODS
(Open Elective-II)

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- To understand the theory and application of the finite element method for analyzing structural systems.
- To learn Approximation theory for structural problems as the basis for finite element methods
- To learn formulations for a variety of elements in one, two, and three dimensions. Implementations of element formulations will be examined using Matlab.
- To understand modeling and analysis of structures using planar, solid, and plate elements

Course Outcomes: Student will be able to

- Understands the concept of Finite Element Method and realize its limitations.
- Able to formulate 1D, 2D and 3D element and distinguish between linear and higher order elements.
- Applying 1D , 2D and 3D elements to solve different static and dynamic problems.

UNIT-I

Introduction to Finite Element Method, solution method using FEM, descretisation, Boundary conditions, load application, types of elements comparison, Stress and Equilibrium, Boundary conditions. Strain-Displacement relations. Stress-strain relations.
One Dimensionla problems: Finite element modeling, coordinates and shape functions.
Potential Energy approach: Assembly of Gloabal stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions. Quadratic shape functions.

UNIT-II

Analysis of trusses and frames: Element stiffness matrix for a truss member. Analysis of plane truss with number of unknowns not exceeding two at each node. Analysis of frames with two translations and a rotational degree of freedom at each node.
Analysis of Beams: Element stiffness matrix for two nodded, two degrees of freedom per node beam element.

UNIT-III

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions.
Finite element modeling of Axisymmetirc solids subjected to Axisymmetric loading with triangular elements.

UNIT-IV

Two dimensional four nodded isoprarametric elements and numerical integration.
Steady state heat transfer analysis: Ond dimensional analysis of a find and two dimensional analysis of thin palate. Analysis of uniform shaft subjected to torsion.

UNIT-V

Dynamic Analysis: Formulation of finite element mode, element matrices, evaluation of Eigen values and Eigen vectors for a stepped bar and a beam.
Time dependent field problems: Application to one dimensional heat flow in a rod. Finite element formation to three dimensional problems in stress analysis. Types of elements used.
Convergence requirements and geometric isotropy. Local, natural and global coordinates. Introduction to Finite Element Analysis Software.

Suggested Readings:

1. Tirupathi R. Chandraputla and Ashok, D. Belgundu" Introduction to Finite Elements in Engineering", pearson Education, 2002, 3rd Edition.
2. Rao S.S., "The Finite Element Methods in Engineering", pergamon Press, 1989.
3. Segerlind, L.J. "Applied Finite Element Analysis", Wiley Publication, 1984.
4. Reddy J.N., "An Introduction to Finite Element Method", McGraw-Hill Company, 1984.

PC751 BM

BIOSIGNAL & IMAGE PROCESSING LAB

Instruction	3 Periods per week
Duration of University Examination	3 Hours
Semester End Examination	50 Marks
Sessionals	25 Marks
Credits	1

Course Objectives:

- Understand the signal processing techniques used for biosignal s.
- Understand the image processing techniques used for medical images.

Course Outcomes:

1. to design and implement digital filters for noise reduction of biological signals
2. to implement various feature extraction algorithms on biosignals
3. to perform image denoising of medical images
4. to examine image enhancement techniques
5. to apply statistical signal processing techniques on biosignals and medical images.

Experiments on Signal Processing

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

Experiments on Image Processing

1. Reading and displaying JPEG and BMP images.
2. Negative of an image.
3. Contrast Stretching
4. Logarithmic Transform.
5. Power-law Transform.
6. Transpose of an image.
7. Filtering in spatial domain
   a. High pass filter.
   b. Low pass filter
   c. Laplacian filter.
8. Filtering in frequency domain
   a. Low pass filter
   b. High pass filter

   c. Butterworth low-pass & high-pass filters.
   d. Gaussian low pass& high pass filter
9. determine the image after applying the threshold
10. Highlight a specific range of gray levels in a given image.
11. Enhance the given image by Histogram processing & Histogram Equalization.
12. Edge detection operators

PW761BM

PROJECT WORK – I

Instruction	2 Periods per week
Sessionals	50 Marks
Credits	4

The Objective of the project seminar is to actively involve the student in preparation of the final year project with regard to following components

- Problem definition and specifications
- Literature survey, familiarity with research journals
- Board knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of bar (activity) charts.
- Presentation - Oral and Written.

The Department can initiate the work related to project allotment at the end of III year 2nd semester and finalize it in the first two weeks of the IV year 1st semester.

First 4 weeks of IV year 1st semester will be spend on special lectures by faculty members, research scholars and PG students of the department and invited lectures by engineers from industries and R&D institutions. The objective of these preliminary talks will be to expose students to real life practical problems, and methodology to solve the technical problems.

Seminar schedule will be prepared by the coordinator for all the students from 5th week to the last week of the semester which should be strictly adhered to.

Each student will be required to

1. Submit a one page synopsis before the seminar for display on notice board.
2. Give a 20 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write-up on the talk delivered.
4. Actively participate in the seminars.

At least two teachers will be associated with the evaluation of the project seminar for the award of the Sessional marks, which should be on the basis of performance on all the three items stated above.

Note: Three periods will be assigned to each project guide irrespective of the number of projects guided.

MC952SP

NATIONAL SERVICE SCHEME (NSS)

Instruction per week	3 Hours
CIE	50Marks
Credits	3 units

Course Objectives:

- To help in Character Moulding of students for the benefit of society
- To create awareness among students on various career options in different fields
- To remould the students behaviour with assertive skills and positive attitudes
- To aid students in developing skills like communication, personality, writing and soft skills
- To educate students towards importance of national integration, participating in electoral process etc by making them to participate in observing important days.

List of Activities:

1. Orientation programme about the role of NSS in societal development
2. Swachh Bharath Programme
3. Guest lecture's from eminent personalities on personality development
4. Plantation of saplings/Haritha Haram Programme
5. Blood Donation / Blood Grouping Camp
6. Imparting computer education to school children
7. Creating Awareness among students on the importance of Digital transactions
8. Stress management techniques
9. Health Checkup Activities
10. Observation of Important days like voters day, World Water Day etc.
11. Road Safety Awareness Programs
12. Energy Conservation Activities
13. Conducting Programme's on effective communication skills
14. Awareness programme's on national integration
15. Orientation on Improving Entrepreneurial Skills
16. Developing Effective Leadership skills
17. Job opportunity awareness programs in various defence, public sector undertakings
18. Skill Development Programmes
19. Creating awareness among students on the Importance of Yoga and other physical activities
20. Creating awareness among students on various government sponsored social welfare schemes for the people.

Note: *At least Ten Activities should be conducted in the Semester***.** Each event conducted under Swachh Barath, Plantation and important days like voters day, world water day may be treated as a separate activity.

With effect from the academic year 2018-2019

MC9535P

SPORTS

Instruction per week	3 Hours
CIE	50Marks
Credits	3 units

Course Objectives:

- To develop an understanding of the importance of sport in the pursuit of a healthy and active lifestyle at the College and beyond.
- To develop an appreciation of the concepts of fair play, honest competition and good sportsmanship.
- To develop leadership skills and foster qualities of co-operation, tolerance, consideration, trust and responsibility when faced with group and team problem-solving tasks.
- To develop the capacity to maintain interest in a sport or sports and to persevere in order to achieve success.
- To prepare each student to be able to participate fully in the competitive, recreational and leisure opportunities offered outside the school environment.

Course Outcomes:

1. Students' sports activities are an essential aspect of university education, one of the most efficient means to develop one's character and personal qualities, promote the fair game principles, and form an active life position.
2. Over the past year, sports have become much more popular among our students. Let us remember the most memorable events related to sports and physical training.
3. Special attention was paid to team sports. Our male and female games and sports have achieved remarkable progress at a number of competitions.
4. Our teams in the main sports took part in regional and national competitions. Special thanks to our team in track and field athletics, which has been revitalized this year at ICT and which has won Javelin competition.
5. Staff of our faculties and students of Sports, Physical Development, & Healthy Lifestyle of Faculty congratulates everyone on the upcoming New Year and wishes you robust health and new victories in whatever you conceive.

I. Requirements:

i) Track Paint (students should bring)
ii) Shoes
iii) Volley Ball, Foot Ball and Badminton (Shuttle)
iv) Ground, Court, indoor stadium and swimming pool

II. Evaluation Process: *Total Marks 50*

i) 20 marks for internal exam (continuous evaluation)
   a) 8 marks for viva
   b) 12 marks for sports & fitness
ii) 30 marks for end exam
   a) 10 marks for viva
   b) 20 marks for sports & fitness

MC951SP

YOGA PRACTICE

Instruction per week	3 Hours
CIE	50Marks
Credits	3 units

Course Objectives:

- Enhances body flexibility
- Achieves mental balance
- Elevates Mind and Body co-ordination
- Precise time management
- Improves positive thinking at the expense of negative thinking

Course Outcomes:

1. Students will become more focused towards becoming excellent citizens with more and more discipline in their day-to-day life.
2. An all-round development-physical, mental and spiritual health-takes place.
3. Self-discipline and discipline with respect society enormouly increases.
4. University environment becomes more peaceful and harmonious.

UNIT-I

Introduction Yoga definition-Health definition from WHO - Yoga versus Health - Basis of Yoga - yoga is beyond science- Zist of 18 chapters of Bhagavadgita - 4 types of yoga: Karma, Bhakti, Gnyana and Raja yoga – Internal and External yoga - Elements of Ashtanga yoga (Yama, Niyama, Asana, Pranayama, Prathyahara, Dharana, Dhyana and Samadhi) - Pancha koshas and their purification through Asana, Pranayama and Dhyana.

UNIT-II

Suryanamaskaras (Sun Salutations) Definition of sun salutations - 7 chakras (Mooladhaar, Swadhishtaan, Manipura, Anahata, Vishuddhi, Agnya and Sahasrar) - Vaious manthras (Om Mitraya, Om Ravaye, Om Suryaya, Om Bhanave, Om Marichaye, Om Khagaye, Om Pushne, Om Hiranya Garbhaye, Om Adhityaya, Om Savitre, Om Arkhaya, and Om Bhaskaraya) and their meaning while performing sun salutations - Physiology - 7 systems of human anatomy - Significance of performing sun salutations.

UNIT-III

Asanas (Postures) Pathanjali's definition of asana - Sthiram Sukham Asanam - 3rd limb of Ashtanga yoga - Loosening or warming up exercises - Sequence of perform in asanas (Standing, Sitting, Prone, Supine and Inverted) - Nomenclature of asanas (animals, trees, rishis etc) - Asanas versus Chakras - Asanas versus systems - Asanas versus physical health -Activation of Annamaya kosha.

UNIT-IV

Pranayama (Breathing Techniques) Definition of Pranayama as per Shankaracharya - 4th limb of Ashtanga yoga – Various techniques of breathing - Pranayama techniques versus seasons - Bandhas and their significance in Pranayama - Mudras and their significance in Pranayama - Restrictions of applying bandhas with reference to health disorders - Pranayama versus concentration - Pranayama is the bridge between mind and body - Pranayam versus mental health - Activation of Pranamaya kosha through Pranayama.

UNIT-V

Dhyana (Meditation) Definition of meditation - 7th limb of Ashtanga yoga - Types of mind (Conscious and Sub-Conscious) - various types of dhyana. Meditation versus spiritual health - Dharana and Dhyana -Extention of Dhyana to Samadhi - Dhyana and mental stress - Activation of Manomaya kosha through dhyana - Silencing the mind.

Suggested Reading:

1. Light on Yoga by BKS lyengar
2. Yoga education for children Vol-1 by Swami Satyananda Saraswati
3. Light on Pranayama by BKS lyengar
4. Asana Pranayama Mudra and Bandha by Swami Satyananda Saraswati
5. Hatha Yoga Pradipika by Swami Mukhtibodhananda
6. Yoga education for children Vol-11 by Swami Niranjanananda Saraswati
7. Dynamics of yoga by Swami Satyananda Saraswati