SCHEME OF INSTRUCTION

B.E. (Biomedical Engineering)

VIII - 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.	PE-V*	Professional Elective-V	30	70	3	0	0	3	3
2.	OE-III*	Open Elective-III	30	70	3	0	0	3	3
3.	MC901EG	Gender Sensitization	30	70	3	0	0	3	3 Units
4.	PW862BM	Project Work –II / Internship	50	100	--	--	4	4	8
Total			**140**	**310**	**09**	**0**	**04**	**13**	**14**

Professional Elective-V	
PE801BM	Medical Device Regulations
PE802BM	Bio Transport Process
PE803BM	Artificial Intelligence & Neural Networks in Medicine
PE804BM	Communication Technologies in Medicine

Open Elective-III	
*OE801BM	Instrumentation Engineering
*OE802BM	Human Machine Interface
OE801CE	Road Safety Engineering
OE802CE	Green Building Technologies
OE801CS	Data Science Using R
OE801EC	Global and Regional Satellite Navigation System
OE801EE	Illumination and Electric Traction
OE801ME	Composite Materials
OE802ME	Industrial and Financial Management
OE803ME	3D Printing Technology

***OE801BE & *OE802BE Electives offered only for CE/CS/EC/EE/ME**

PC801 BM

MEDICAL DEVICE REGULATIONS
(PROFESSIONAL ELECTIVE-V)

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

1. examine the methods for testing medical devices
2. to summarise FDA device regulations
3. interpret the rules of Indian Medical device regulations 2017
4. to elaborate the design process using failure analysis
5. to adopt the procedures for analysing medical devices

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)

PC802 BM

BIOTRANSPORT PROCESS
(PROFESSIONAL ELECTIVE-V)

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 fundamental principles of cell biology, molecular biology, and engineering towards understanding transport processes in the body and design of medical devices.
- Apply knowledge of math, engineering and science to understand the principles of mass transport.

Course Outcomes: Successfully the student will be able to:

1. mathematically define and describe general bio transport
2. study the various models of heat transfer to achieve homeostasis
3. comprehend mass transfer in Kidneys and lungs
4. apply mass transfer principles in designing dialyzers and oxygenators
5. construct compartmental models to analyse drug delivery and blood flow

UNIT- I

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

UNIT- II

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

UNIT- III

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

UNIT- IV

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

UNIT- V

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

Suggested Reading:

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

PE803 BM

ARTIFICIAL INTELLIGENCE & NEURAL NETWORKS IN MEDICINE (PROFESSIONAL ELECTIVE-V)

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 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.
- Provide hands-on experience in selected applications

Course Outcomes: Successfully the student will be able to:

1. understand the concepts and techniques of artificial intelligence
2. to modern knowledge representation system using predicate logic
3. relate fuzzy logic concepts for knowledge representation
4. to build artificial neural networks
5. to apply artificial intelligence and artificial neural networks for medical applications

UNIT-I

Introduction to Artificial Intelligence: Definition. A.I Applications, A I 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: Artificial Intelligence.
3. Kishen Mehrotra, Sanjay Rawika, K Mohan; Artificial Neural Network
4. Laurene Fausett,"Fundamentals of Neural Networks: Architectures,Algorithms and Applications".PEI 3rd Edition, 2008.

PE804 BM

COMMUNICATION TECHNOLOGIES IN MEDICINE
(PROFESSIONAL ELECTIVE-V)

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 students to various modulation and demodulation techniques
- To analyze different parameters of communication techniques.
- It also focuses on pulse modulation and demodulation
- To introduce basics of telemedicine.

Course Outcomes: Successfully the student will be able to:

1. use of different analog modulation and demodulation techniques
2. understand the concept of frequency and phase modulation
3. discuss different pulse modulation techniques used for communication
4. extending the knowledge for digital modulation techniques
5. illustrate the principles of telemedicine

UNIT-I

Amplitude modulation Amplitude modulation systems: suppressed carrier system (DSB-SC), signals side band modulation (SSB), vestigial sideband modulation (VSM), amplitude modulation with large Carrier (AM), QAM, Generation of AM waves, de-modulation of AM waves, Frequency division multiplexing, AM Transmitters & Receivers.

UNIT-II

Angle modulation Frequency Modulation (FM) & Phase Modulation (PM), Relation between FM & PM, Spectrum of FM, Narrow band FM, Wideband FM, Phasor diagram of AM & FM, FM generation & demodulation, FM transmitters & Receivers, Pre-emphasis & De-emphasis.

UNIT-III

Pulse modulation Sampling, Sampling theorem, Natural Sampling, Flat top sampling, PAM, PWM, PPM, Quantization, PCM, DPCM, Delta modulation, Delta sigma modulation, Adaptive delta modulation, Time division multiplexing.

UNIT-IV

Digital modulation techniques ASK, BPSK, BFSK, DEPSK, DPSK, QPSK, QASK, MSK, M-ary FSK, M-ary PSK, Probabilty of error for ASK, BPSK, BFSK.

UNIT-V

Fundamentals of Telemedicine, block diagram of TM system, definition of TM, Telecommunication based biomedical systems- Tele radiology, Tele Pathology, TELE cardiology, Tele oncology, Tele surgery, Tele education and Tele Monitoring

Suggested reading:

1. Taub& Schilling, Principle of Communication System, 2nd Ed., Tata McGraw Hill.
2. B.P. Lathi, Modren and analog Communication System, 3rd Ed. Oxford University Press
3. A .C. Norris, Essentials of Telemedicine and Telecare, John Wiley & Sons, 2002
4. Carlon, Communication System, 4th Ed. Tata McGraw Hill.
5. Kennedy & Davis, Electronics Communication System, 4th Ed. Tata McGraw Hill.
6. Olga Ferrer-Roca & M. Sosa ludicissa, Handbook of Telemedicine, IOS Press 2002

***OE801BM**

INSTRUMENTATION ENGINEERING
(OPEN 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:

- to understand the need of instrument
- understand the principle of operation of different sensors
- to design signal conditioning circuits for different industrial sensors
- to design the instruments.

Course Outcomes:

1. Can design various signal conditioning circuits
2. Can apply the principles in applications

UNIT-I
Instrument, block diagram of an instrument, Principles of transduction and measurement, Sensor Classification, Functional specifications of sensors; static and dynamic characteristics of measurement systems. Primary sensors, bimetals, Bellows, Bourdon tube, capsule, diaphragm, applications.

UNIT-II
Resistive sensors. Potentiometers, Strain gages, RTDs, Thermistors, LDR. Signal conditioning. Wheatstone bridge, balance and deflection measurements. Instrumentation amplifier. Interference types and reduction. Shield grounding. Isolation amplifiers, Applications.

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

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

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

Suggested Reading:

1. Ramon Pallas-Areny and John G.Webster, *Sensors and signal conditioning*, John Wiley and Sons, 1991.
2. Principles of measurements by J P Bentely
3. Electronic measurements and instrumentation by A K Sawhany

***OE802 BM**

HUMAN-MACHINE INTERFACE
(OPEN ELECTIVE-III)

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

Course Objectives:

- To stress the importance of a good interface design.
- To understand the importance of human psychology in designing good interfaces.
- To motivate students to apply HMI in their day – to – day activities.
- To bring out the creativity in each student – build innovative applications that are user friendly.
- To encourage students to indulge into research in Machine Interface Design.

Course Outcomes: Learner will be able to…

1. To design user centric interfaces.
2. To design innovative and user friendly interfaces.
3. To apply HMI in their day-to-day activities.
4. To criticise existing interface designs, and improve them.
5. To Design application for social and technical task.

UNIT-I

Introduction - Introduction to Human Machine Interface, Hardware, software and operating environment to use HMI in various fields.

The psychopathology of everyday things – complexity of modern devices; human-centered design; fundamental principles of interaction; Psychology of everyday actions- how people do things; the seven stages of action and three levels of processing; human error

UNIT-II

Understanding goal directed design - Goal directed design; Implementation models and mental models; Beginners, experts and intermediates – designing for different experience levels; Understanding users; Modeling users – personas and goals.

UNIT-III

GUI - benefits of a good UI; popularity of graphics; concept of direct manipulation; advantages and disadvantages; characteristics of GUI; characteristics of Web UI; General design principles.

UNIT-IV

Design guidelines - perception, Gesalt principles, visual structure, reading is unnatural, color, vision, memory, six behavioral patterns, recognition and recall, learning, factors affecting learning, time.

UNIT-V

Interaction styles - menus; windows; device based controls, screen based controls.

Communication - text messages; feedback and guidance; graphics, icons and images; colours.

Suggested Reading:

1. Alan Dix, J. E. Finlay, G. D. Abowd, R. Beale “Human Computer Interaction”, Prentice Hall.
2. Wilbert O. Galitz, “The Essential Guide to User Interface Design”, Wiley publication.
3. Alan Cooper, Robert Reimann, David Cronin, “About Face3: Essentials of Interaction design”, Wiley publication.
4. Jeff Johnson, “Designing with the mind in mind”, Morgan Kaufmann Publication.
5. Donald A. Normann, “Design of everyday things”, Basic Books; Reprint edition 2002.

OE 801 CE

ROAD SAFETY ENGINEERING

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

Course Objectives

- Introduction to various factors considered for road safety and management
- Explain the road safety appurtenances and design elements
- Discuss the various traffic management techniques

Course Outcomes

1. Prepare accident investigation reports and database
2. Apply design principles for roadway geometrics improvement with various types of traffic safety appurtenances/tools
3. Manage traffic including incident management

UNIT - I

Road accidents: Causes, scientific investigations and data collection, Analysis of individual accidents to arrive at real causes, statistical methods of analysis of accident data, Basic concepts of Road accident statistics,Safety performance function: The empirical Bayes method Identification of Hazards road location. Application of computer analysis of accident data.

UNIT-II

Safety in Road Design: Operating the road network for safety, highway operation and counter measures, road safety audit, principles-procedures and practice, code of good practice and checklists, vehicle design factors & Driver characteristics influencing road safety.

UNIT - III

Road Signs and Traffic Signals: Classification, Location of Signs, measures of sign effectiveness, Types of visual perception, sign regulations, sign visibility, sign variables, Text versus symbols. Road Marking: Role of Road markings, Classification, visibility. Traffic Signals: Need, Signal face. Illumination and location of Signals, Factors affecting signal design, pedestrians' safety, fixed and vehicle actuated signals. Design of signa1s, Area Traffic control. Delineators, Traffic Impact Attenuators, Road side rest areas, Safety Barriers, Traffic Aid Posts.

UNIT-IV

Traffic Management Techniques: Integrated safety improvement and Traffic Calming Schemes, Speed and load limit, Traffic lights, Safety cameras, Tests on driver and vehicles, pedestrian safety issues, Parking, Parking enforcement and its influence on Accidents. Travel Demand Management; Methods of Traffic management measures: Restriction of Turning Movements, Oneway streets, Tidal Flow Operation Methods, Exclusive Bus Lanes and Closing Side-streets; Latest tools and techniques used for Road safety and traffic management. Road safety issues and various measures for road safety; Legislation, Enforcement, Education and Propaganda, Air quality, Noise and Energy Impacts; Cost of Road Accidents.

UNIT-V

Incident Management: Introduction, Characteristics of Traffic Incidents, Types of Incidents, Impacts, Incident management process, Incident traffic management; Applications of ITS: Motorist information, Equipment used; Planning effective Incident management program, Best practice in Incident management programs. National importance of survival of Transportation systems during and after all natural disasters especially cyclones, earthquakes, floods etc and manmade disasters like sabotage, terrorism etc.

Suggested Reading

1. Guidelines on Design and Installation of Road Traffic Signals,IRC:93.
2. Specification for Road Traffic Signals, IS: 7537-1974.
3. Principles and Practice of Highway Engineering by L.R. Kadiyali andN.B.Lal.
4. Hand book of T.E. Myer Kutz, Editor McGraw Hill, 2004.

OE 802 CE

GREEN BUILDING TECHONOLOGIES

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

Course Objectives:

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

Course Outcomes:

- Understand the fundamentals of energy use and energy processes in building.
- Identify the energy requirement and its management.
- Know the Sun-earth relationship vis-a-vis its effect on climate.
- Be acquainted with the end-use energy requirements.
- 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 air quality – Air-conditioning requirement - Visual perception - Illumination requirement - Auditory requirement.

UNIT-III

Climate, solar radiation and their influences: Sun-earth relationship and the energy balance on the 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 for energy management.

Suggested Reading:

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 801 CS

DATA SCIENCE USING R

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

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 Itemset, Data Structure Overview, Mining Algorithm Interfaces, Auxiliary Functions, Sampling from Transaction, Generating SyntheticTransaction 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 Itemset, Closed Itemset And Association Rules.

Frequent Itemset: Mining Methods, Pattern Evaluation Methods, Sentiment Analysis

Suggested Reading:

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

OE 801 EC

GLOBAL AND REGIONAL SATELLITE NAVIGATION SYSTEMS

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 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, 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.

OE801EE

ILLUMINATION AND ELECTRIC TRACTION

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

Course Outcomes:

- To introduce the students and understand Utilization of electrical energy for various applications like industrial heating, welding etc.,
- To understand the concept of illumination, and know the applications of various lamps to factory lighting, street lighting etc.
- To understand the concept of electrification of traction system.

UNIT- I

Industrial Heating: Advantages and methods of electric heating. Description, operation and performance of resistance ovens — Design of elements. Core type, Coreless type furnaces, High frequency eddy current heating, Dielectric heating. Arc furnace. Electric welding, Resistance welding, welding transformer and its rating, various types of Electric arc welding and electric resistance welding.

UNIT- II

Schematic Utilization and Connection Diagrams for Motor Control: Two supply sources for 3 phase Induction motors. Direct reversing, remote control operation, and jogging operating of Induction motor. Contactor control circuit. Push button control stations. Over load relays, limit switches, float switches. Interlocking methods for reversing control.

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 vapour lamps — 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. Traction Motors: Desirable characteristics, d.c series motors, a.c series motors 3-phase induction motors, d.c motor series & parallel control, Energy saving.

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

Suggested Readings:

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 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.

With effect from Academic year 2018-19

OE801ME

COMPOSITE MATERIALS

(Open Elective-III)

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 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: At the end of this course student is expected reach the following outcomes.

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 achitectures.

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.

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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 Reading:

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.

OE802ME

INDUSTRIAL AND FINANCIAL MANAGEMENT

(Open Elective-III)

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 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: At the end of this course student is expected reach the following outcomes.

1. Understand the different phases of product life cycle, types of manufacturing systems, plant layout optimization problems and role of scheduling function in better utilization of resources
2. Understand the Fundamental concepts of quality control, process control, material control and apprceiate the importance of MRP-I and MRP –II.
3. Know the different terminology used in financial management and understand the different techniques of capital budgeting and various types of costs involved in running an industrial organisation.

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, 11th ed. 2001.

OE803ME

3D PRINTING TECHNOLOGY

(Open Elective-III)

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

Course Objectives:

- To understand the fundamental concepts of 3D Printing, its advantages and limitations.
- To classify various types of 3D Printing Processes and know their working principle, advantages, limitations etc.
- To have a holistic view of various applications of these technologies in relevant fields such as Mechanical, Bio-medical, Aerospace, electronics etc.

Course Outcomes: Upon competition of this course the student will be able to:

1. Understand the significance of 3D Printing and compare it with conventional manufacturing process.
2. Classify various types of 3D PRINTING processes, rapid tooling and understand the working principle and applications of them with case studies.
3. Know the various types of errors that creep up while saving the .STL file format and also will be able to appreciate the features of various types of software's used in 3D Printing.
4. Appreciate the diversified applications of 3D PRINTING in various fields like biomedical, aerospace, automobile, defence, architecture etc.

UNIT-I

Introduction: Prototyping fund3D Printingentals, Historical development, Fund3D Printingentals of 3D PRINTING, Advantages and Limitations of 3D PRINTING , Commonly used Terms, Classification of 3D PRINTING process, 3D PRINTING Process Chain: Fund3D Printingental Automated Processes, Process Chain.

UNIT-II

Liquid-based 3D Printing Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

Solid-based 3D Printing Systems: L3D Printinginated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT-III

Powder Based 3D Printing Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Laser Engineered Net Shaping (LENS), Electron Be3D Printing Melting.

UNIT-IV

3D Printing Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software's: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

UNIT-V

Applications of 3D Printing : Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewellery Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Printed electronics, Biopolymers, Packaging

Suggested Reading:

1. Chua C.K., Leong K.F. and LIM C.S, Rapid prototyping; Principles and Applications, World Scientific Publications , Third Edition, 2010.
2. D.T. Ph3D Printing and S.S. Dimov, Rapid Manufacturing, Springer, 2001.
3. TerryWohlers, Wholers Report 2000, Wohlers Associates, 2000.
4. PaulF.Jacobs, Rapid Prototyping & Manufacturing ASME Press, 1996

PC761 BM

PROJECT WORK – II / INTERNSHIP

Instruction	4 Periods per week
University Examination	100 Marks
Sessionals	50 Marks
Credits	8

'Solving a real life problem' should be the focus of U.G. project. Faculty members should propose the project briefs (scope and references) well in advance, which should be made available to the students at the department library. The project could be classified as hardware, software, modeling, and stimulation. It should involve one or many elements of techniques such as analysis, design and synthesis.

The department will appoint a project coordinator who will coordinate the following:

Grouping of students (max. 3 in a group)
Allotment of projects and projects guides
Project monitoring at regular intervals

All projects allotment is to be completed by the 2nd week of VII-Semester, so that students get sufficient time for completion of the project.

All projects will be monitored at least twice in a semester through students' presentation. Sessional marks are to e based on the Grades/Marks, awarded by a monitoring committee comprising of faculty members as well as by the supervisor.

Efforts should be made that some of the projects are carried out in industries with the help of industry coordinators. Problems can also be invited from the industries to be worked out through U.G. projects. Common norms will be established for final documentation of the project report by the respective departments.

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* Excellent /Very Good / Good / Satisfactory / Unsatisfactory

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