FACULTY OF ENGINEERING

Scheme of Instruction & Examination

(CBCS Curriculum for the Academic Year 2019-2020)

and

Syllabus

of

B.E. VII and VIII Semester

of

Four Year Degree Programme

(With effect from the academic year 2019– 2020)
(As approved in the faculty meeting held on 25-06-2019)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad – 500 007

2019

Contents

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Common Courses Syllabi

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List of Common Courses offered

S. No.	Subject Code	Subject Name
OPEN ELECTIVE – II		
1	OE701 CE	Green Building Technologies
2	OE701 CS	Database Management Systems
3	OE702 EC	Fundamentals of IoT
4	OE701 EE	Non-Conventional Energy Sources
5	OE701ME	Entrepreneurship
OPEN ELECTIVE – III		
6	OE702 CE	Road Safety Engineering
7	OE703 CS	Data Science Using R Programming
8	OE703 EC	Global and Regional Satellite Navigation Systems
9	OE702 EE	Illumination and Electric Traction systems
10	OE702 ME	Mechatronics
MANDATORY COURSE		
11	MC951 SP	Yoga Practice
12	MC952 SP	NSS
13	MC953 SP	Sports

Course Code	Course Title						Core / Elective
OE701CE	**Green Building Technologies**						**Open Elective-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To impart knowledge of the principles behind the green building technologies.
- To know the importance of sustainable use of natural resources and energy.
- To understand the principles of effective energy and resources management in buildings.
- To bring awareness of the basic criteria in the green building rating systems.
- To understand the methodologies to reduce, recycle and reuse towards sustainability.

Course Outcomes

After completing this course, the student will be able to

1. Define a green building, along with its features, benefits and rating systems.
2. Describe the criteria used for site selection and water efficiency methods.
3. Explain the energy efficiency terms and methods used in green building practices.
4. Select materials for sustainable built environment & adopt waste management methods.
5. Describe the methods used to maintain indoor environmental quality.

UNIT-I

Introduction to Green Buildings: Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT- II

Site selection and planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, etc.

Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT-III

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy.

Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT-IV

Building materials: Methods to reduce embodied energy in building materials: (a) Use of local building materials (b) Use of natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks, (c) use of materials with recycled content such as blended cements, pozzolona cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) reuse of waste and salvaged materials
Waste Management: Handling of construction waste materials, separation of household waste, on-site and off-site organic waste management

UNIT-V

Indoor Environmental Quality for Occupant Comfort and Well being: Daylighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics.
Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

Suggested Readings:

1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.
3. ***Alternative building materials and technologies*** by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. ***Non-Conventional Energy Resources*** by G. D. Rai, Khanna Publishers.
5. ***Sustainable Building Design Manual***, Vol.1 and 2, TERI, New Delhi 2004.
6. Mike Montoya, ***Green Building Fundamentals***, Pearson, USA, 2010.
7. Charles J. Kibert, ***Sustainable Construction - Green Building Design and Delivery***, John Wiley & Sons, New York, 2008.
8. Regina Leffers, ***Sustainable Construction and Design***, Pearson / Prentice Hall, USA, 2009.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>OE 701 CS</td><td colspan="6">Data Base Management Systems</td><td>Open Elective-II</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>NIL</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

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

At the end of the course students 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-RelationshipModel, 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, EmbeddedSQL, Dynamic SQL, Functions and Procedural Constructs, Recursive Queries, Advanced SQL **Features.**

Relational Database Design: Features of Good Relational Design, Atomic Domains andFirst Normal Form, Functional-Dependency Theory, Decomposition using Functional Dependencies.

UNIT – IV

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

Transactions: Transaction Concepts, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability

UNIT – V

Concurrency Control: Lock-based Protocols, Timestamp-based Protocols, Validation-basedProtocols, 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-BasedRecovery, 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

Course Code	Course Title						Core / Elective
OE702EC	**Fundamentals of IoT**						**Open Elective-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	**3**	**-**	**-**	**-**	**30**	**70**	**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:

At the end of the course, the students 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: Definition and Characteristics of IoT, Physical Design of IoT: Things in IoT,IoT protocols, Logical Design of IoT: IoT functional Blocks, Communication Models, APIs, IoT enabling TEchnologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics (Ref 1)
IoT Applications: Smart Home, Smart Cities, Smart Environment, Smart Energy, Smart Retail and Logistics, Smart Agriculture and Industry, Smart Industry and smart Health (Ref1)

UNIT – II

Internet Principles and communication technology: Internet Communications: An Overview – IP,TCP,IP protocol Suite, UDP. IP addresses – DNS, Static and Dynamic IP addresses, MAC Addressess, TCP and UDP Ports, Application Layer Protocols – HTTP,HTTPS, Cost Vs Ease of Production, Prototypes and Production, Open Source Vs Closed Source. Prototyping Embedded Devices – Sensors, Actuators, Microcontrollers, SoC, Choosing a platform, Prototyping Hardware platforms – Arduino, Raspberry Pi. Prototyping the physical design – Laser Cutting, 3D printing, CNC Milling (Ref 2)

UNIT – III

API Development and Embedded programming: Getting started with API, Writing a new API, Real time Reactions, Other Protocols, Techniques for writing embedded code:Memory management, Performance and Battery Life, Libraries, Debugging. (Ref 2)
Developing Internet of Things: IoT design Methodology, Case study on IoT System for weather monitoring (Ref 1)

UNIT – IV

IoT Systems - Logical Design using Python: Introduction to Python, Data Types and Structures, Control Flow, Functions, Modules, Packages, File Hnadling, Date/Time Operations., Classes, Python packages for IoT (Ref 1 and Ref 3) IoT Physical Devices and Endpoints: Raspberry Pi, Interfaces of Pi, Programming pi with Python - Controlling LED and LDR using Pi with python programming.

UNIT – V

Cloud computing and Data analytics and IoT Product Manufacturing: Introduction to Cloud storage models and Communication APIs, Amazon webservices for IoT, Skynet IoT Messaging Platform.

Introduction to Data Analytics for IoT(Ref 1). Case studies illustrating IoT Design – Smart Lighting, Weather Monitoring, Smart Irrigation.(Ref 1) Business model for IoT product manufacturing, IoT Startups, Mass manufacturing, Ethical issues in IoT.(Ref 2)

Suggested Reading:

1. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , ArshdeepBahga, VPT Publisher, 1st Edition, 2014.
2. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally. Wiley India Publishers.
3. Fundamentals of Python, Kenneth A Lambert and B.L. Juneja, Cenage Learning
4. *Internet of Things* - Converging Technologies for smart environments and Integrated ecosystems, River Publishers.
5. *Internet of things* -A hands on Approach, Arshdeep Bahga, Universities press.

Course Code	Course Title						Core / Elective
OE701EE	**Non Conventional Energy Sources**						**Open Elective-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

To impart the knowledge of basics of different non conventional types of power generation & power plants in detail so that it helps them in understanding the need and role of Non-Conventional Energy sources particularly when the conventional sources are scarce in nature

Course Outcomes

On completion of course the student will be able to :

1. Understand the different nonconventional sources and the power generation techniques to generate electrical power.
2. Understand the Solar energy power development and different applications.
3. Understand different wind energy power generation techniques and applications.
4. Design a prescribed engineering sub-system
5. Recognize the need and ability to engage in lifelong learning for further developments in this field.

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 Wind-Basic components of WECS -Classification of WECS -Site selection considerations -Advantages and disadvantages of WECS -Wind energy collectors -Wind electric generating and control systems - Applications of Wind energy -Environmental aspects.

UNIT- IV

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

UNIT-V

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

Suggested Reading:

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

Course Code	Course Title						Core / Elective
OE701ME	**Entrepreneurship**						**Open Elective-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

Course Outcomes:

At the end of the course, the students will be able to

1. Understand Indian IndustriaI Environment, Entrepreneurship and Economic growth, Small and Large scale Industries, Types and forms of enterprises.
2. Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
3. Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
4. Apply the concepts of Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques
5. Understand the Behavioral aspects of entrepreneurs, Time Management, Various approaches of time management, their strengths and weakness. The urgency addiction and time management matrix.

UNIT-I

Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.

UNIT-II

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

UNIT-III

Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis, project financing in India.

UNIT-IV

Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of tax burden.

UNIT-V

Behavioural aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

Suggested Readings:

1. Vasant Desai, *"Dynamics of Entrepreneurial Development andManagement",* Himalaya Publishing House, 1997
2. Prasanna Chandra, *"Project-Planning, Analysis, Selection,Implementation and Review",* Tata Mcgraw-Hill Publishing CompanyLtd. 1995.

3. Stephen R. Covey and A. Roger Merrill, *"First Things First",* Simon and Schuster Publication, 1994.
4. G.S. Sudha, *"Organizational Behaviuor",* 1996.
5. Robert D. Hisrich, Michael P. Peters, *"Entrepreneurship",* Tata Me Graw Hill Publishing Company Ltd., 5lh Ed., 2005.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>OE 702 CE</td><td colspan="6">Road Safety Engineering</td><td>Open Elective-III</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>NIL</td><td>3</td><td>0</td><td>0</td><td>0</td><td>30</td><td>70</td><td>3</td></tr>
</table>

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

At the end of the course, the students will be able to

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 Readings:

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.

Course Code	Course Title						Core / Elective
OE 703 CS	**Data Science Using R Programming**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	**3**	**-**	**-**	**-**	**30**	**70**	**3**

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

Course Outcomes:
At the end of the course, the students will be able to
1. Use various data structures and packages in R for data visualization and summarization
2. Use linear , non-linear regression models, and classification techniques for data analysis
3. Use clustering methods including K-means and CURE algorithm

UNIT – I
Data Science: Introduction to data science, Linear Algebra for data science, Linear equations, Distance, Hyper planes, Half spaces, Eigen values, Eigenvectors.

UNIT II
Statistical Modeling, Random variables, Probability mass/density functions, sample statistics, hypothesis testing.

UNIT III
Predictive Modeling: Linear Regression, Simple Linear Regression model building, Multiple Linear Regression, Logistic regression

UNIT IV
Introduction to R Programming, Getting started with R: Installation of R software and using the interface, Variables and data types, R Objects, Vectors and lists, Operations: Arithmetic, Logical and Matrix operations, Data frames, functions, Control structures, Debugging and Simulation in R.

UNIT V
Classification:, performance measures, Logistic regression implementation in R, K-Nearest neighbors (KNN), K-Nearest neighbors implementation in R, Clustering: K-Means Algorithm, K-Means implementation in R.

Suggested Readings:

1. R Programming for Data science, by Roger D Peng, Lean Publishing.
2. Introduction to Data Science by Rafael A Irizarry, Lean Publishing

Course Code	Course Title						Core / Elective
OE 703 EC	**Global and Regional Satellite Navigation Systems**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	**Credits**
	L	T	D	P			
NIL	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To understand fundamentals of Global Position System (GPS)
- To know the signal structures and error sources of GPS
- To study architectures of different GPS based augmentation systems.
- To learn the basic concepts of other GNSS constellations.
- To know the idea about Regional based navigation systems.

Course outcomes:

At the end of the course, the students will be able to

1. Familiarize with the GNSS fundamentals and GPS architecture.
2. Describe the different types of GNSS Signals and GNSS Datum.
3. Analyze the GPS errors and their modeling techniques
4. Understanding various GPS data processing and GPS integration techniques.
5. Conceptualize the augmentation systems and regional navigation satellite systems

UNIT – I

GPS Fundamentals: GPS Constellation, Principle of operation, GPS Orbits, Orbital mechanics and satellite position determination, Time references, Geometric Dilution of Precision: GDOP, VDOP, PDOP. Solar and Sidereal day, GPS and UTC time.

UNIT – II

GPS Signal Structure: GPS signals, C/A and P-Codes, GPS Signal generation, Spoofing and anti-spoofing. **Error sources in GPS:** Satellite and receiver clock errors, Ephemeris error, Atmospheric errors, Receiver measurement noise and UERE

UNIT – III

GPS Augmentation systems: Classification of Augmentations Systems, Relative advantages of SBAS and GBAS, Wide area augmentation system (WAAS) architecture, Local area augmentation system (LAAS) concept, GPS Aided GEO Augmented Navigation (GAGAN), European Geostationary Navigation Overlay Service (EGNOS) and MTSAT Satellite-based Augmentation System (MSAS). Differential GPS

UNIT – IV

Other GNSSs: Architecture and features of Russian Global Navigation Satellite System (GLONASS), European Navigation System (Galileo), Chinese Global Navigation System (BieDou-2/COMPASS), GNSS Applications.

UNIT – V

Regional Navigation Satellite Systems (RNSS): Indian Regional Navigation Satellite System (IRNSS), Japan's Quasi-Zenith Satellite System (QZSS), Chinese Area Positioning System (CAPS).
GPS Integration: GPS/GIS, GPS/INS, GPS/Pseudolite, GPS/Cellular integrations.

Suggested Reading:

1. Rao G.S., "Global Navigation Satellite Systems – with Essentials of Satellite Communications", Tata McGraw Hill, 2010.
2. Sateesh Gopi, "Global Positioning System: Principles and Applications", TMH, 2005.
3. Elliot D. Kaplan, "Understanding GPS Principles and Applications", 2/e, Artech House, 2005.

4. Paul D Groves, "Principles of GNSS, Inertial, and Multi-sensor Integrated Navigation Systems" Artech House Publishers, 2017
5. Basudeb Bhatta," Global Navigation Satellite Systems: Insights into GPS, GLONASS, Galileo, Compass", B.S. Publications, 2010

Course Code	Course Title						Core / Elective
OE 702 EE	**Illumination and Electric Traction Systems**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- 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

Course Outcomes:

On successful completion of course, students will be able to:

1. Design the resistive and inductive heating and calculate the requirements of heating power for an industrial need
2. Analyze the type of motor control required and select the type and rating of motor.
3. Understand and Design illumination for different application
4. Understand the traction and use of DC machines
5. Analyze the traction mechanics to arrive at a rating of drive.

UNIT-

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 Reading:

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

Course Code	Course Title						Core / Elective
OE 702 ME	**Mechatronics**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives: Student has to understand the

- How to identify, formulate, and solve engineering problems
- The design a system, component, or process to meet desired needs within realistic constraints
- The how to use the techniques, skills, and modern engineering tools necessary for engineering practice
- The use of drive mechanisms and fluid power systems
- The use of industrial electronic devices
- The demonstrate the design of modern CNC machines, and Mechatronics elements

Course Outcomes:

At the end of the course, the students will be able to

1. Model and analyze electrical and mechanical systems and their interconnection
2. Integrate mechanical, electronics, control and computer engineering in the design of Mechatronics systems
3. Do the complete design, building, interfacing and actuation of a Mechatronics system for a set of specifications
4. Be proficient in the use of fluid power systems in various Mechatronics applications
5. Demonstrate the use of industrial electronic devices
6. Demonstrate the design of modern CNC machines, and Mechatronics elements

UNIT-I

Introduction to mechanization & automation: Need of interface of electrical & electronic devices with mechanical elements, the concept of Mechatronics, Flow chart of Mechatronics system, elements of Mechatronics system, drive mechanisms, actuators, feedback devices and control system, application in industries and systems development

UNIT-II

Drive mechanisms: Feeding and indexing, orientation, escapement and sorting devices, conveyor systems Introduction to electrical actuators: A.C. servomotors, D.C. servomotors, stepper motors

UNIT-III

Introduction to fluid power systems: Industrial Pneumatics and hydraulics, merits of fluid power, pneumatic & hydraulic elements symbols, study of hydraulic control valves, pumps & accessories, hydraulic circuits & mechanical servo control circuits, Electro-hydraulic and Hydropneumatic circuits

UNIT-IV

Introduction to industrial electronic devices: Diodes, Transistors, Silicon Controlled Rectifiers (SCR), Integrated Circuits (IC), Digital Circuits, Measurement systems & Data acquisition systems: sensors, digital to analog and analog-to-digital conversion, signal processing using operational amplifiers, introduction to micro processor & micro controller, Temperature measurement interface and LVDT interface, Systems response

UNIT-V

Design of modern CNC machines and Mechatronics elements: machine structures, guide ways, spindles, tool monitoring systems, adaptive control systems, Flexible manufacturing systems, Multipurpose control machines, PLC programming

Suggested Readings:

1. William Bolton, Mechatronics: Electronic control systems in mechanical and electrical engineering, 6th edition, Pearson Education
2. HMT Ltd, Mechatronics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1998
3. Michaels Histand& David G, Alciatore, Introduction to Mechatronics and Measurement Systems, Tata McGraw-Hill International Edition
4. Devdas Shetty, Richard A. Kolk, Mechatronics System Design, Cengage Learning
5. S.R. Majumdar, Oil Hydraulic Systems – Principles & Maintenance, McGraw-Hill Publishing Company Limited, New Delhi
6. Godfrey Onwubolu, Mechatronics: Principles and Applications, Butterworth-Heinemann

Course Code	Course Title						Core / Elective
MC 901 CE	**Gender Sensitization**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	0	0	0	**30**	**70**	3

Course Objectives

- To develop students' sensibility with regard to issues of gender in contemporary India.
- To provide a critical perspective on the socialization of men and women.
- Information about some key biological aspects of genders.
- Reflect critically on gender violence.
- Exposure on egalitarian interactions between men and women.

Course Outcomes

After completing this course, the student will be able to

- Develop a better understanding of important issues related to gender in contemporary India.
- Sensitize to basic dimensions of the biological, sociological, psychological and legal aspects of gender through discussion of materials derived from research, facts, everyday life, literature and film.
- Get a finer grasp of how gender discrimination works in our society and how to counter it.
- Develop a sense of appreciation of women in all walks of life.

UNIT – I

Understanding Gender: Why should we study it? Socialization: making women, making men. Introduction, preparing for womanhood, growing up male, first lessons in caste, different masculinities, just relationships, being together as equals, Mary Kom and Onler Love and acid just do not mix, love letters, mothers and fathers, further reading, rosa parks, the brave heart.

UNIT – II

Gender and Biology: Missing women, sex selection and its consequences, declining sex ratio, demographic consequence, gender spectrum, beyond the binary, two or many, struggles with discrimination, our bodies, our health.

UNIT – III

Gender and Labour: Housework, the invisible labour, my mother doesn‘t work, share the Load, women's work, its politics and economics, fact and fiction, unrecognized and unaccounted work, wages and conditions of work.

UNIT – IV

Issues of Violence: Sexual harassment - Say No! , Sexual harassment, no eve teasing, coping with everyday harassment, “Chupulu” domestic violence, speaking out, is home a safe place? When women unite, rebuilding lives, new forums for justice, thinking about sexual violence, blaming the victim, I fought for my life, the caste face of violence.

UNIT – V

Gender Studies Knowledge: Through the lens of gender, point of view, gender and the structure of knowledge. Unacknowledged women artists of Telangana: Whose history? Questions for historians and others: reclaiming a past, writing other histories, missing pages from modern Telangana history.

Suggested Readings:

1. A.Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu, ***Towards a World of Equals: A Bilingual Text book on Gender***, Telugu Akademi, Hyderabad, 1st Edition, 2015.
2. www.halfthesky.cgg.gov.in

Course Code	Course Title						Core / Elective
MP 951 SP	**Yoga Practice**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	0	0	0	**50**	**-**	3

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

After completing this course, the student will be able to

- Acquire an all-round development of physical, mental and spiritual health.
- Maintain a self-discipline way of living and respect in the society increases enormously.
- Become more peaceful and harmonious.
- Control their stress levels in academics as well as personal life.

UNIT – I

Introduction: Yoga definition, health definition from WHO, yoga versus health, basis of yoga, yoga is beyond science, zist of eighteen chapters of Bhagavadgita, four 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, seven chakras (Mooladhaar, Swadhishtaan, Manipura, Anahata, Vishuddhi, Agnya and Sahasrar), various 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, seven 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 and so on), 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 Readings:

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.

Course Code	Course Title						Core / Elective
MC 952 SP	**NSS**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	0	0	0	**50**	**-**	3

Course Objectives

- To help in character molding of students for the benefit of society.
- To create awareness among students on various career options in different fields.
- To remold the students behavior 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.

Course Outcomes

After completing this course, the student will be able to

-

List of Activities:

1. Orientation programme about the role of NSS in societal development.
2. Swachh Bharath Program.
3. Guest lecture's from eminent personalities on personality development.
4. Plantation of saplings/Haritha Haram Program.
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 and so on.
11. Road Safety Awareness Programs.
12. Energy Conservation Activities
13. Conducting Programs on effective communication skills.
14. Awareness programs on national integration.
15. Orientation on Improving Entrepreneurial Skills.
16. Developing Effective Leadership skills.
17. Job opportunity awareness programs in various defense, public sector undertakings.
18. Skill Development Program.
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.

Course Code	Course Title						Core / Elective
MC 953 SP	**Sports**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	0	0	0	**50**	**-**	3

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

After completing this course, the student will be able to

- 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.
- 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.
- Special attention was paid to team sports. Our male and female games and sports have achieved remarkable progress at a number of competitions.
- 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.
- 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

Requirements:

a. Track Paint (students should bring)
b. Shoes
c. Volley Ball, Foot Ball and Badminton (Shuttle)
d. Ground, Court, indoor stadium and swimming pool

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

FACULTY OF ENGINEERING

Scheme of Instruction & Examination

(CBCS Curriculum for the Academic Year 2019-2020)

and

Syllabi

B.E. VII and VIII Semester

of

Four Year Degree Programme

In

Civil Engineering

(With effect from the academic year 2019– 2020)
(As approved in the faculty meeting held on 25-06-2019)

Issued by
Dean, Faculty of Engineering
Osmania University, Hyderabad – 500 007
2019

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VII - Semester
(CIVIL ENGINEERING)

S. No.	Course Code	*Course Title*	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/Drg	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	**PC 701 CE**	Str. Engg. Design and Drawing – II (Steel)	3	1	-	4	30	70	3	3
2	**PC 702 CE**	Estimation Costing & Specifications	3	1	-	4	30	70	3	3
3	**PC 703 CE**	Finite Element Techniques	3	-	-	3	30	70	3	3
4	**PC 704 CE**	Prestressed Concrete	3	-	-	3	30	70	3	3
5	**PC 705 CE**	Foundation Engineering	3	-	-	3	30	70	3	3
6		Open Elective – II	3	-	-	3	30	70	3	3
7		Open Elective – III	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
9	**PC 751 CE**	Computer Application Lab	-	-	2	2	25	50	3	1
10	**PW 761 CE**	Summer Internship	-	-	2	2	50	-	-	4
11	**PW 762 CE**	Project Work – I	`	-	-	-	50	-	-	2
			21	**02**	**04**	**27**	**335**	**540**		**28**

Open Elective – II			**Open Elective – III**		
S. No.	Course Code	Course Title	S.No.	Course Code	Course Title
1	**OE 701 CE****	Green Building Technologies	1	**OE 702 CE****	Road Safety Engineering
2	**OE 701 CS**	Database Management Systems	2	**OE 703 CS**	Data Science Using R Programming
3	**OE 702 EC**	Fundamentals of IoT	3	**OE 703 EC**	Global and Regional Satellite Navigation Systems
4	**OE 701 EE**	Non-Conventional Energy Sources	4	**OE 702 EE**	Illumination and Electric Traction systems
5	**OE 701ME**	Entrepreneurship	5	**OE 702 ME**	Mechatronics

PC: Professional Course PE: Professional Elective
L: Lectures T: Tutorials Pr : Practicals Drg: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour
2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

Note-2: * The students have to undergo a Summer Internship of four weeks duration after VI semester and credits will be awarded in VII semester after evaluation.
** Subject is not offered to the students of Civil Engineering Department.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PC 701 CE</td><td colspan="6">Structural Engineering Design and Drawing – II (Steel)</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Steel Structures</td><td>3</td><td>1</td><td>0</td><td>0</td><td>30</td><td>70</td><td>4</td></tr>
</table>

Course Objectives

- Understand the basic concepts of welded plate girder design.
- Learn the basic principles of gantry girder design.
- Study the various types of bridges, bridge bearings and their design procedures.

Course Outcomes

After completing this course, the student will be able to

- Analyze and design the plate girder and gantry girder.
- Design the railway steel bridges and bridge bearings.

UNIT – I

Plate Girders: Design of welded plate girders for static loads, connections, intermediate and bearing stiffeners, web and flange splices.

UNIT – II

Gantry Girders: Basic principles, codal provisions and detailed design.
Bearings: Types and materials, detailed design of bearings for bridges.

UNIT – III

Bridges: Deck and trough type bridges, economical span, bridge rules (Railway Board, Ministry of Railways), detailed design of plate girder bridges and truss bridges.

***Suggested Readings*:**

1. N. Subramanyam, ***Design of Steel Structures***, Oxford University Press, 2008.
2. B.C. Punmia, ***Comprehensive Design of Steel structures***, Laxmi Publishers, 2001.
3. P. Dayaratnam, ***Design of steel Structures***, S. Chand & Company Ltd, 2003.
4. N. Krishna Raju, ***Design of Bridges***, Oxford and IBH Publishers, New Delhi, 1998.
5. Relevant ***I.S. Code books*** on Design of Steel Structures.

e-Resources:

1. http://nptel.ac.in
2. http://mhrd.gov.in/e-contents
3. http://spoken-tutorial.org/

<table>
<tr><td>Course Code</td><td colspan="4">Course Title</td><td colspan="2"></td><td>Core / Elective</td></tr>
<tr><td>PC 702 CE</td><td colspan="6">Estimation Costing & Specifications</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Building Material and Construction</td><td>3</td><td>1</td><td>0</td><td>0</td><td>30</td><td>70</td><td>4</td></tr>
</table>

Course Objectives

- Understand the basic principles and specifications for estimations
- Know the basic procedures for Tenders and Tender documents
- Understand the detailed estimation of buildings, roads and Irrigation structures

Course Outcomes

- Will be able to prepare tender documents
- Will be able to prepare estimates for various engineering structures
- Will be able to prepare schedule for civil engineering works

UNIT – I

Basic Principles and Specifications: General and detailed specifications of works, departmental procedures to the construction works, types of estimates, various types of contract, turnkey projects, essentials of contracts and conditions of contracts, schedule of rates, standard data, rate analysis, bill of quantities.

UNIT – II

Tenders and Documentation: Tenders, preparation of tenders, tender documentation, Tender notice, work order, earnest money deposit, and security money deposits, comparative statements, additional conditions mentioned by tender, and those implications. Measurement book and muster roll, advances in tender procedures. National/International bidding. BOT, BOOT and PPP projects. Role of IT in tenders and construction industry.

UNIT – III

Estimation of Buildings and Roads: Traditional residential buildings, advanced buildings (earth work, footings, columns, beams and slabs etc) by long wall and short wall method and centre line method, bar bending schedules, estimation of reinforcement quantities. **Estimation of road works:** Using levels (cross sections and longitudinal sections).

UNIT – IV

Estimation of Irrigation Structures: Pipe culvert, slab culvert, simple bridge, irrigation canal including earth work (cutting and banking), retaining walls, overhead water tank and aqueduct.

UNIT – V

Software's in estimation: Preparation of estimates using computer software/excel sheets/available software's, introduction to MS Project.

Suggested Readings:

1. Dutta, B.N. (2005). ***"Estimating and Costing in Civil Engineering:Theory and Practice***.‖ S. Dutta & Co., Luknow.
2. Chakraborthi, M. (2002). ***—Estimating. Costing and Specifications in Civil Engineering***.‖ M. C. Chakraborthi, Kolkata.
3. Jagjit Singh. (1996). ***—Estimating and Costing in Civil Engineering.***‖ Galgotia publications, New Delhi

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PC 703CE</td><td colspan="6">Finite Element Techniques</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Numerical Methods</td><td>3</td><td>0</td><td>0</td><td>0</td><td>30</td><td>70</td><td>3</td></tr>
<tr><td colspan="8">Course Objectives
➢ To introduce the transition from 2D to 3D structural problems (linear and non-linear).
➢ Analyze all kinds of loads and their respective effects.
➢ To introduce a high-end computer oriented numerical analysis tool.
Course Outcomes
After completing this course, the student will be able to
➢ Define the behavior of structural elements (2D and 3D).
➢ Analyze and evaluate structural frames through stiffness matrices.
➢ Model structures using FEM based software's such as ANSYS, ABAQUS, MSC NASTRAN and so on.</td></tr>
</table>

UNIT - I

Introduction to Finite Method: Variational approach, Rayleigh-Ritz and Galerkin's methods. Stiffness matrix for two noded bar, truss, and beam elements, problems with three degrees of freedom.

UNIT – II

Stiffness Matrix: Two noded beam element with three degrees of freedom per node. Transformation, generation of stiffness matrix for frames. Strain-displacement and stress – strain relationship in an elastic continuum (linear problems). Equations of equilibrium, and boundary conditions. Plane stress and plane strain problems.

UNIT – III

Formulation of Finite Element Method: Using principle of virtual displacement. Determination of stiffness matrix for three noded triangular element (constant strain triangle), and four noded rectangular element for plane stress and plane strain problems. Convergence criteria for selection of displacement models. Discretisation of continuum. Assembly of global stiffness and load matrices. Displacement boundary conditions.

UNIT – IV

Isoparametric Finite Elements: Direct construction of shape functions for higher order elements using natural co-ordinate system. Shape functions for eight noded parabolic curved iso-parametric element. Determination of element stiffness matrix for four noded quadrilateral element. Use of Jacobian, and Gauss quadrature techniques. Load matrix for eight noded rectangular isoparametric element (for body forces and surface traction).

UNIT – V

Strain Displacement: Stress – strain relation for axisymmetric problems. Stiffness matrix for three noded ring element. Volume co-ordinates and stiffness matrix for four noded tetrahedron element. Exposure to FEM based software's.

Suggested Readings:

1. O.C. Zienkiewicz and R.L. Taylor, ***The Finite Element Method***, Vol.I, McGraw Hill, 1989.
2. K.J. Bathe, ***Finite Element Procedures***, Pearson Education .Inc, 2006.
3. S.S. Bhavakatti, ***Finite Element Analysis***, New Age International Publishers, 2005.
4. C.S. Krishna Moorthy, ***Finite Element Analysis***, McGraw Hill, 1991.
5. T.R. Chandrupatla, ***Finite Element Analysis for Engineering and Technology***, Universities Press, 2004.

<table>
<tr><td>Course Code</td><td colspan="4">Course Title</td><td colspan="2"></td><td>Core / Elective</td></tr>
<tr><td>PC 704 CE</td><td colspan="6">Prestressed Concrete</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Reinforced Cement Concrete</td><td>3</td><td>0</td><td>0</td><td>0</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- Understand the basic concept of prestressed concrete and materials used.
- Learn the analysis prestress and load balancing concept.
- Study the flexural and shear design of prestressed concrete beam sections.
- Learn the design of prestressed concrete continuous beam.
- Know the concepts of deflections and end blocks of prestressed concrete sections.

Course Outcomes

After completing this course, the student will be able to

- Apply the concept of prestressing and determine the losses of prestress.
- Analyze the prestressed concrete beam and suggest the cable profile for beam.
- Design the prestressed concrete beam for flexure and shear.
- Analyze the prestressed continuous beam and determine the concordant cable profile.
- Estimate the deflection of a prestressed concrete beam and design the end block.

UNIT – I

Introduction To Prestressed Concrete: Historical development, principles of prestressed concrete. Definition, classification and systems of prestressing. Materials for prestressed concrete.
Loss of prestress: Losses of prestress in pre-tensioned and post-tensioned members.

UNIT – II

Analysis of Prestress: Basic assumptions, analysis of prestress, resultant stress, pressure line, kern points, cable profiles, load balancing concept, stress diagrams for prestress, dead load and live load.

UNIT – III

Simply Supported Continuous Beams: concordant cable profile, analysis of continuous prestressed concrete beams.
Design of Sections: Flexural strength design of rectangular, I and T sections using IS code provisions.

UNIT – IV

Design For Shear: Basic concept of shear design, shear failure, flexural shear failure, shear compression failure, shear tension failure, shear strength of beams (a) unfrocked in flexure and (b) cracked in flexure.

UNIT – V

Deflections: Necessity of deflection estimation, limitations of deflections. Deflections of pre-stressed concrete beams with uniformly distributed and point loads.
End Block: Types of end blocks and Importance of end block, Analysis and design of end block by Guyon method and IS method for not more than two cables.

Suggested Readings:

1. T.Y. Lin and N.H. Burns, ***Design of prestressed concrete structure***, Jon Wildy and sons, 1982.
2. A.H. Nilson, ***Design of prestressed concrete***, John Wiley and Sons, 1982.
3. N. Krishna Raju, ***Design of prestressed concrete structure***, Tata McGraw Hill Book Co., 1996.
4. G.S. Pandit and S.P. Gupta, ***Prestressed Concrete***, CBS Publishers, 1995.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PC 705 CE</td><td colspan="6">Foundation Engineering</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Soil Mechanics</td><td>3</td><td>0</td><td>0</td><td>0</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- Learn the definition, necessity, types and suitability of different foundation systems.
- Understand the procedures of geotechnical design of foundations.
- Understand the necessity and usage of different foundation construction related aspects.
- Learn about different methods of geotechnical investigations and its role in selection and design of foundations.

Course Outcomes

After completing this course, the student will be able to

- Understand the stress distribution in soils.
- Calculate bearing capacity of shallow foundation.
- Design pile foundation and machine foundation.
- To learn various aspects of foundation.

UNIT – I

Stress Distribution In Soils: Boussinesq's theory – Computation of increment in vertical stress due to application of a point load (its distribution on horizontal, vertical planes), uniformly distributed circular and rectangular areas –Pressure bulb – Significant depth - Construction and use of Newmark's chart – Westergaard's theory – Validity of elastic theories – Contact pressure distribution.

UNIT – II

Introduction to Foundations: Functional requirements – types – differentiation of shallow and deep foundations – suitability

Safe Bearing Capacity of Shallow Foundations: Definitions - (a) Based on theories –Types of shear failures - Terazaghi's theory for safe bearing capacity of shallow foundations – Effect of type of shear failure / shape of the footing / water table – Provisions of IS : 6403-1981 (b) Based on field tests : Plate load test / Standard Penetration test

Allowable Bearing Capacity of Shallow Foundations: Settlement Analysis – Total settlement – Elastic settlement – Consolidation settlement (ultimate & after any given period – correction for construction period) – Permissible uniform & differential settlements – Proportioning of footings.

UNIT – III

Pile Foundations: Necessity – types based on load transfer mechanism / material / method of installation / functional use – Estimation of vertical load carrying capacity of a single pile – static formulae / Dynamic formulae / Pile load tests – Cyclic pile load test for separation of total capacity in to bearing and friction components – Pile groups – necessity – efficiency of Pile groups - estimation of group capacity – Negative Skin friction – Concept of Piled raft foundation.

UNIT – IV

Caissons: Necessity – types – Essential components of open (well) / box (floating) / Pneumatic caissons - suitability – Sinking of caissons – correction for tilt & shift.

Machine Foundations: differentiation with static foundations – vibration characteristics (frequency / amplitude/ resonance) – types of machines and machine foundations – additional design requirements

Geotechnical Investigations: Necessity – Principles of exploration - objectives – Soil profile – collection of disturbed & undisturbed soil samples – samplers & quality of samples - methods – Trial pit / Bore hole method – Log of bore hole details

UNIT – V

Foundation construction related aspects.

Timbered / braced excavations: Necessity - methods – suitability – distribution of pressure – reaction of struts.

Dewatering: Necessity – methods – sumps (ditches) / well point system (single /multi-stage) / deep well system / elector-osmonsis method – merits & demerits – suitability **Coffer dams**: necessity – types – suitability

Underpinning: Necessity – methods (pin / pile) - suitability

Geosynthetics: Classification – functions – applications.

Suggested Readings:

1. Bowles, E. (2012). **"*Foundation analysis and Design*"**, McGraw-Hill Publications.
2. Das, B.M. (2012). **"*Principles of Foundation Engineering*"**, Sengrece Publications.
3. Arora, K.R. (2012). **"*Soil Mechanics & Foundation Engineering*"** Standard Publications.
4. Verghese, P.C. (2012). **"*Foundation Engineering*"**, PHI Publications.

<table>
<tr><td>Course Code</td><td colspan="4">Course Title</td><td colspan="2"></td><td>Core / Elective</td></tr>
<tr><td>PC 751 CE</td><td colspan="6">Computer Application Lab</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>NIL</td><td>0</td><td>0</td><td>0</td><td>2</td><td>25</td><td>50</td><td>1</td></tr>
</table>

Course Objectives

- Understand the application of software's in civil engineering.
- Analysis and design of structural members using software techniques.
- Use of software knowledge for solving fluid mechanics related problems.
- Solving geotechnical problems using software.

Course Outcomes

After completing this course, the student will be able to

- To use software skills to solve civil engineering related analysis and design.
- To analyze and design of RCC beam using limit state design.
- To analyze and solve problems related to hydraulic structures using software.
- To compute bearing capacity and other geotechnical related problems using software.

List of Experiments to be performed:

1. Calculation of shear force *I* bending moment at any section for a simply supported beam carrying a u.d.l., shorter than span.
2. Structural design of an RCC beam section using limit state method, given are the grade of concrete, grade or steel, BM and SF.
3. A rectangular cross section is subjected t o a non-central fo r ce parallel to axis of member. Determine the stresses at any location of the section. Direct and bending stresses.
4. Calculation of normal depth and critical depth in a trapezoidal channel
5. Computation of discharge over a rectangular notch using velocity of approach
6. Determination of pre and post jump depths from known specific energy values
7. Calculation of Φ-index
8. Estimation of specific capacity and maximum pumping rate of a well
9. Analysis of pipe network in water distribution systems
10. Flood routing using Muskigham‘s method
11. Design of an irrigation channel using Kennedy‘s theory
12. Design of trapezoidal notch canal fall
13. Compute distribut ion of increment in vertical stress due to applied point load on a
    (a) Horizontal Plane
    (b) Vertical plane. Using the computed values, plot the distribution utilizing VC as front end tool.
14. Compute the values of a pressure bulb and using the values plot pressure bulb utilizing VC as front end tool.
15. Compute t he consolidation settlement duly dividing the strata in to infinitesimally small layers to fulfill the Terzaghi‘s assumption.
16. Compute earth pressure on to a retaining wall and check its stability.
17. Compute bearing capacity of a shallow foundation as per IS: 6403 -1980
18. Develop a code in C to design a single vertical pile, pile group to suit various ground conditions.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PW 761 CE</td><td colspan="6">Summer Internship</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Knowledge of Civil Engineering</td><td>0</td><td>0</td><td>0</td><td>2</td><td>50</td><td>-</td><td>1</td></tr>
</table>

Course Objectives

- To identify the topic and make a visit to the industry.
- To observe the salient features of the activity.
- To interact with the plant team and get clarity about the operations.
- To present a comprehensive report on the visit.

Course Outcomes

After completing this course, the student will be able to

- Learn how to approach an industry and get permission.
- Make technical visit to that plant/site.
- Learn the Civil Engineering aspects of that plant/site.
- Prepare a report on the visit covering all salient features of that plant/site/activity.

The students will be attending to Industry for Internship to various Government and Private Organizations. Students should take help of teaching staff and Alumni to identify the industry for practical training. The students should prepare a report about their internship during the vacation period for presentation.

The department will appoint a coordinator who will coordinate the following.

- Grouping of students
- Allotment of originations for Internship.
- Monitoring and presentation by students after the Internship.

Course Code	Course Title						Core / Elective
PW 762 CE	**Project Work - I**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	0	0	0	2	**50**	**-**	1

Course Objectives

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes

- Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
- Evaluate different solutions based on economic and technical feasibility
- Effectively plan a project and confidently perform all aspects of project management
- Demonstrate effective written and oral communication skills

The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester.
The department will appoint a project coordinator who will coordinate the following:
Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries)

- Grouping of students (max 3 in a group)
- Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide.
Seminar schedule will be prepared by the coordinator for all the students from the 5th week to the last week of the semester which should be strictly adhered to.

Each group will be required to:

1. Submit a one-page synopsis before the seminar for display on notice board.
2. Give a 30 minutes' presentation followed by 10 minutes' discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

- Problem definition and specification
- Literature survey
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of bar (activity) charts
- Presentation- oral and written.

SCHEME OF INSTRUCTION& EXAMINATION
B.E. – VIII SEMESTER
(CIVIL ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/Drg	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	**PC 801 CE**	Construction Management & Technology	3	-	-	3	30	70	3	3
2		Professional Elective – III	3	-	-	3	30	70	3	3
3		Professional Elective – IV	3	-	-	3	30	70	3	3
4		Professional Elective – V	3	-	-	3	30	70	3	3
5	**MC901 CE**	Gender Sensitization	3	-	-	3	30	70	3	3U
Practical/ Laboratory Courses										
6	**PW961 CE**	Project Work – II	-	-	4	4	50	100	-	8
7		Mandatory Course	3	-	-	3	30	70	3	3U
			15	**-**	**4**	**19**	**200**	**450**		**20**

Professional Elective – III			**Professional Elective – IV**		
S. No.	Course Code	Course Title	S. No.	Course Code	Course Title
1	**PE 801 CE**	Retrofitting and Rehabilitation of Structures	1	**PE 805 CE**	Structural Dynamics
2	**PE 802 CE**	Computer Aided Analysis and Design	2	**PE 806 CE**	Design with Geosynthetics
3	**PE 803 CE**	Applied Hydrology	3	**PE 807 CE**	Groundwater Management
4	**PE 804 CE**	Introduction to Climate Change	4	**PE 808 CE**	Intelligent Transportation Systems
Professional Elective – V			**MANDATORY COURSE**		
1	**PE 809 CE**	Prefabrication Engineering	1	**MC 951 SP**	Yoga Practice
2	**PE 810 CE**	Principles of Green Building Practices	2	**MC 952 SP**	NSS
3	**PE 811 CE**	Advanced Reinforced Concrete Design	3	**MC 953 SP**	Sports
4	**PE 812 CE**	Traffic Engineering & Infrastructure Design			

PC: Professional Course PE: Professional Electives
OE: Open Electives PW: Project Work MC: Mandatory Courses
L: Lectures T: Tutorials Pr : Practicals Drg: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour
2) The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PC 801 CE</td><td colspan="6">Construction Management & Technology</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Engineering Mathematics & Estimation and Costing</td><td>3</td><td>1</td><td>0</td><td>0</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- Describe different techniques of construction management projects.
- Illustrate economics of construction management projects.
- Study the Safety Engineering practices of construction management projects.

Course Outcomes

After completing this course, the student will be able to

- Understand and apply various techniques involved in planning and construction stages.
- Analyze and optimize the materials used in construction.
- Assess and prevent the conflicts and accidents that may occur during various stages of construction.

UNIT – I

Introduction: Objectives of planning, construction stages, Sequence of events in general Civil Engineering construction projects, Construction Schedule. Development of management techniques, Bar charts, Gantt charts, CPM and PERT techniques, Network analysis examples.

UNIT - II

Introduction to Cost Analysis: Cost reduction in construction management. Cost time analysis, Crashing the Network, Optimization, Resource Leveling and smoothing.

UNIT – III

Development of Operations Research (OR): Quantitative Analysis and Decision Making, need for linear programming, standard form of Linear programming, Graphical Method, Case studies.

UNIT – IV

An algebraic overview of Simplex Method: solving minimization and maximization problems, case studies.

UNIT – V

Safety Engineering: Safety program, Direct and Indirect loss due to accident, Classification of Construction accidents and causes, Location hazards and their elimination, Safety in demolition of buildings, Safety in storage and handling of materials and equipments.

Suggested Readings:

1. Robert L. Peurifoy and William B. Ledbetter, Construction ***Planning, Equipment, and Methods***, McGraw-Hili International Editions, New Delhi, 1985
2. FrankHarris and Ronald Mc.Caffer,modern ***Construction Management***. Blookwell science L1d,2001.
3. Mahesh Varma, ***Construction Equipment and Its Planning And Application***, Metropolitan Book Company Pvt Ltd., New Delhi, 1994.
4. H.N.Ahuja, ***Construction Performance Control By Networks***, John willey & sons, New York, 1976.

Course Code	Course Title						Core / Elective
PE 801 CE	**Retrofitting and Rehabilitation of Structures**						Elective
Prerequisites	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Concrete Technology	3	0	0	0	**30**	**70**	3

Course Objectives

- Understand the basic concepts of building maintenance.
- Understand the causes, mechanisms and prevention of deterioration of structures.
- Understand the methods of condition assessment of structures.
- Learning the materials, methodology and techniques of repair.
- Learning the methods and strategies of retrofitting of structures.

Course Outcomes

After completing this course, the student will be able to

- Distinguish between various definitions related to building repair and maintenance.
- Differentiate the types of defects, damage and explain the various deterioration mechanisms in structures.
- Classify and explain the various non-destructive tests and condition assessment procedures.
- Describe various repair materials and techniques.
- Explain the various retrofitting and rehabilitation procedures.

UNIT – I

Introduction to Building Maintenance: Definitions of repair, renovation, remodeling, restoration, retrofitting and rehabilitation. Need for maintenance, types of maintenance, routine maintenance works in buildings.

Types of Defects and Damages in Structures: During pre-construction stage, construction stage and post construction stage. Cracks – Types, Causes and Characteristics

UNIT – II

Mechanisms of Deterioration of Structures & Their Prevention: Concrete Structures: Defects in fresh concrete - Early frost damage, plastic shrinkage, plastic settlement (subsidence), subgrade settlement, formwork movements. Deterioration in hardened concrete: (a) Physical causes - aggregate shrinkage, drying shrinkage, crazing (b) Chemical causes: acid attack, sulphate attack, chloride attack, carbonation, alkali aggregate reaction, corrosion of reinforcement, (c) Thermal causes: Freeze-thaw, temperature variations, differential thermal expansions, humidity influences, (d) Structural causes: improper design loads, accidental overloads, creep

Steel Structures: Causes and types of deterioration, mechanism of corrosion, prevention of deterioration, influence of design details, design and fabrication errors, stresses due to erection.

UNIT – III

Condition Assessment and Non-destructive Testing & Evaluation*:* Definition, objectives and stages of condition assessment, Destructive and partially destructive tests. Non-destructive tests (NDTs). Classification of NDT procedures, Visual Inspection, Ultrasonic Testing methods (Impact echo, Pulse velocity, Pulse echo), Rebound hammer (IS 13311), Windsor probe test, Half-cell potential measurement, Electrical resistivity measurement, Carbonation depth measurements, Petrographic Analysis, Electromagnetoc methods for Rebar detection, Ground Penetrating radar, Infrared thermography, Radiography, Radio isotope gauges, Remote viewing, Hammer sounding, Chain drag techniques.

UNIT – IV

Repair Materials and Techniques*:* Repair Methodology, Repair materials (cement-based, polymer-based, resin based, microcrete, composites, etc.), compatibility considerations, Repair techniques: Using mortars, dry pack, epoxy bonded pack, pre-placed aggregate concrete, gunite, shotcrete, grouting, polymer impregnation, resin injection, routing & sealing, stitching, surface patching, overlays & surface coatings, autogeneous healing, gravity filling, drilling and plugging

UNIT – V

Retrofitting & Rehabilitation Procedures: Strengthening of Existing Structures – Overview, general procedures, Techniques: section enlargement, composite construction, post-tensioning, stress reduction, strengthening by reinforcement, methods of strengthening in beams, slabs, columns (plate bonding, RC jacketing, FRP methods, concrete overlays, etc) strengthening of substructure (shoring, underpinning)

Suggested Readings:

1. Varghese P. C. (2015), ***Maintenance, Repair & Rehabilitation & Minor Works of Buildings***, PHI Learning Pvt. Ltd, Delhi.
2. Modi P.I. and Patel C.N. (2016), ***Repair and Rehabilitation of Concrete Structures***, PHI Learning Pvt. Ltd, Delhi.
3. Peter H. Emmons, (2001), ***Concrete Repair and Maintenance Illustrated***, Galgotia Publications, New Delhi.
4. Johnson.S.M., (1980), ***Deterioration, Maintenance and Repair of Structures***, Krieger Publishing, Melbourne, Florida.
5. Guha. P.K., (1998), ***Maintenance and Repairs of Buildings***, New Central Book Agency Ltd., Kolkata.
6. SP: 25-1984, (1999), ***Handbook on Causes and Prevention of Cracks in Buildings***, BIS, New Delhi.
7. Guide Book on ***Non-destructive Testing of Concrete Structures***, Training course series No. 17, International Atomic Energy Agency, Vienna, 2002.
8. Hand book on ***"Repair and Rehabilitation of RCC Buildings"***, Published by Director General, CPWD, Govt. of India, 2002.

Course Code	Course Title						Core / Elective
PE 802 CE	**Computer Aided Analysis and Design**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	0	0	0	**30**	**70**	3

Course Objectives

- To learn the software skills for structural design.
- To understand the computing techniques in the field of structural design.
- To study the different software packages for analysis and design.

Course Outcomes

After completing this course, the student will be able to

- Describe the importance of CAD and different software.
- Analyze and design structural components.
- Analyze and design multi-storied structure.
- Analyze and design industrial structural components.
- Analyze and design multi-storied industrial structure.

UNIT – I

Introduction: Introduction to computer aided analysis and design using different software packages.

UNIT – II

Structural Components: Analysis and design of reinforced concrete slabs, beams, columns and footings using different software packages.

UNIT – III

Multi-storied Structure: Analysis and design of multi-storied reinforced concrete building using different software packages.

UNIT – IV

Industrial Structural Components: Analysis and design of industrial roof steel trusses, beams, columns, column bases, plate girders, gantry girders and connections using different software packages.

UNIT – V

Multi-storied Industrial Structure: Analysis and design of multi-storied industrial steel structure using different software packages.

Suggested Readings:

1. C. S. Krishnamoorthy and S. Rajeev, ***Computer Aided Design and Analytical Tools***, Narora, 1993.
2. N. Bicanic, Harald Mang, ***Computer Aided Analysis and Design of Concrete Structures***, 1990.
3. F. Damjanic, ***Computer-aided analysis and design of concrete structures***, Pineridge Press, 1984.
4. S. R. Karve, V. L. Shah, ***Illustrated Design of Reinforced Concrete Buildings***, Structures Publications.
5. Srinivasa Prakash Regalla, ***Computer Aided Analysis and Design***, 2010.

Course Code	Course Title						Core / Elective
PE 803 CE	**Applied Hydrology**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	0	0	0	**30**	**70**	3

Course Objectives

To make the student familiar with the concepts of

- Flood characteristics and flood forecasting systems.
- Various methods of flood routing and hydrologic routing.
- Flood mitigation and estimating its benefits, land management and flood plain management.
- Flood plain adjustments and regulations.
- Hydrologic time series analysis.

Course Outcomes

After completing this course, the student will be able to

- Describe flood characteristics and forecasting flood with provided data (if available).
- Compute and predict the future floods through mathematics of flood routing and can review as well as interpret scientific information.
- Enable themselves to make/decide necessary flood plain adjustments and regulations theoretically.
- Analyze hydrologic time series data.

UNIT – I

Flood Characteristics and Forecasting: Measureable features of a flood (Elevation, discharge, volume, and duration), flood forecasting (unit hydrograph method, meteorological and snow data, and snow field air temperatures), operation of flood forecasting systems.

Space-Time Characteristics of Rainfall: Policy criteria for design flood of a major and minor reservoir, spillways, diversion dams and barrages, design flood criteria for dams and other hydraulic structures (CWC recommendations).

UNIT – II

Flood Routing: Mathematics of flood routing, various methods of flood routing, Hydrologic and Hydraulic routing.

UNIT – III

Flood Mitigation: Flood mitigation reservoirs(purpose, location, size and operation) levees and flood walls (location, maintenance and flood fighting), flood ways, channel improvement, evacuation and flood proofing, land management, flood plain management, estimating benefits of flood mitigation.

UNIT – IV

Flood Plain Adjustments And Regulations: Results of controlling floods, alternatives to controlling floods, range of possible adjustments, practical range of choice, critical characteristics of flood hazards, classification of flood plain land, and regulation of flood plain use, river training works (guide banks, approach and afflux embankments, spurs / groynes, artificial cut-offs, bank protection, pitched banks, and miscellaneous methods).

UNIT – V

Hydrologic Time Series Analysis: Independent and Auto-correlated data, structure of hydrologic time series, trend, jump, seasonality, stationarity, Auto-covariance and Auto-correlation Function, Correlogaram Analysis, spectral Analysis, Analysis of Multi-Variant Hydrologic series.

Suggested Readings:

1. Ven Te Chow (1964), ‗***Hand Book of Applied Hydrology***', McGraw-Hill Publishers, New York.

2. Linsley, R. K. and Franzini A. W. (1992), _***Water Resource Engineering***‘, McGraw-Hill Publishers, New York.
3. Varshney, R. S. (1979), _***Engineering Hydrology***‘, Nem Chand Publishers, Roorkee.
4. Jaya Rami Reddy, P. (1987), _***A. Text Book of Hydrology***‘, Lakshmi Publishers, New Delhi.
5. Daniel H. Hoggan (1989), _***Computer Assisted Flood Plain Hydrology and Hydraulics***‘, McGraw-Hill Publishers, New York.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PE 804 CE</td><td colspan="6">Introduction to Climate Change</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Environmental Science</td><td>3</td><td>0</td><td>0</td><td>0</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- To understand basic concepts of General Circulation Models and their importance.
- To know the features of Indian Summer Monsoon Rainfall (ISMR) and their characteristics.
- To understand the downscaling principles of statistical downscaling and dynamical downscaling.

Course Outcomes

After completing this course, the student will be able to

- Define the impacts of climate change on natural environment.
- Explain the fundamentals of global water balance.
- Explain about climate changes and its impact on climate especially hydrology.
- Brief introduction of climate modeling especially using statistical downscaling techniques.
- Bias correction methods in climate science.

UNIT – I

Climate System: Weather and Climate- Overview of earth-atmosphere- vertical structure of atmosphere- - Heat Balance of Earth Atmosphere- Radiation and temperature- Temperature variation-Laws of radiation-Radiation Balance- variation with latitude

UNIT – II

Introduction of Global water balance: cycling of water on land- role of water cycle-simple water balance- climate variables affecting precipitation- Precipitation and Weather, Humidity, Vapor Pressure-atmospheric stability-causes of instability-classification of clouds-precipitation process

UNIT – III

Monsoon: Global wind circulation- clouds- Types of clouds-Indian summer monsoon Rainfall (ISMR)-characteristics- Inter-annual variability- Floods- droughts- drought Indicators- climate extremes.

UNIT – IV

Causes of Climate Change: Impacts of climate change on hydrology-Modeling of climate change-IPCC scenarios- IPCC Assessment Report (AR5)-physical science basis- Coupled Model Inter-comparison Project (CMIP)- CMIP5 data downloading procedure- Reanalysis data products.

UNIT – V

General Circulation Models (Gcms): Bias correction methods -Downscaling – Types of downscaling-Dynamical downscaling- Regional Climate Models - concepts of statistical downscaling- data reduction techniques -principal component analysis-application of Regression methods.

Suggested Readings:

1. Bonon G B (2008) ***- Ecological Climatology***- Cambridge University Press Edition- II - ISBN-1107268869, 9781107268869.
2. RL Wilby, SP charles, E Zoritaa, B Timbal, P WHetton, LO Mearns (2004) -***Guide lines for use of climate science from Statistical Modeling models.***
3. ***Physical science basis of AR 5 report of IPCC (2013)***- working group I contribution to Assessment Report- https://ipcc.ch/report/ar5/wg1/
4. Rasmus E Benestad, Inger Hanson Baver, Delinag Chen (2008) ***Empirical Downscaling World*** Scientific Publishing Co. Ltd.
5. Vente Chow (1964)- ***Hand Book of Applied Hydrology***- - Mc Graw Hill Co.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PE 805 CE</td><td colspan="6">Structural Dynamics</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Engineering Mechanics, Solid Mechanics & Theory of Structures</td><td>3</td><td>0</td><td>0</td><td>0</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- Study the various types as well as characteristics of loading and formulate the equations of motion.
- Learn the response of un-damped and damped SDOF and MDOF systems under various loadings.
- Employ the approximate and iterative methods to model continuous vibratory systems.
- Understand the dynamic response by numerical methods.

Course Outcomes

After completing this course, the student will be able to

- Know the objectives of dynamic analysis and formulate equation of motion.
- Study the response of free vibration of Single degree Of Freedom (SDOF).
- Study the response of free vibration of multiple degree Of Freedom (MDOF).
- Interpret the dynamic analysis results for design, analysis and research purposes.
- Apply the structural dynamics theory to earthquake analysis and response of the structure.

UNIT – I

Objectives of Dynamic Analysis: Types of prescribed dynamic loading – Characteristics of a dynamic problem – Methods of dicretization: Lumped mass Procedure / Consistent mass procedure/generalized displacements – Single Degree Freedom Systems – Formulation of Equation of Motion: d'Alemberts's Principle e – Influence of Gravity Forces and Ground Motion on equation of motion

UNIT – II

Response of Un-Damped/Damped Free Vibrations Of SDOF Systems: Un-damped/Damped vibrations of SDOF systems subjected to Harmonic loading: Dynamic equilibrium / Accelero Meters / Displacement Meters / Resonant Response / Vibration Isolation – Un-damped / Damped vibrations of SDOF systems subjected Periodic loading –

UNIT – III

Multi Degree Freedom Systems: Formulation of Equations of Motion / Evaluation of Lumped Mass Matrix and consistent mass matrix/ Evaluation of Stiffness Matrix.

Un-damped Free Vibrations: Analysis of Frequency matrix and mode shape matrices using detrimental equation/Flexibility Formulation

UNIT – IV

Normalizing Mode shapes/Analysis of Dynamic Response/Normal Coordinates/ Uncoupled Equations of Motion for un-damped systems.

Practical Vibration Analysis: Stodola Method - Fundamental mode only, Reduction of degrees of freedom, basic concepts in matrix iteration.

UNIT – V

Distributed Parameter Systems: Partial Differential Equation of Motion – Beam Flexure (Elementary case) – Undammed free vibrations (Elementary case) – Analysis of dynamic response – normal coordinates.

***Suggested Readings*:**

1. Walter C. Hurty & Moshe F. Rubinstein, (1964). ***―Dynamics of Structures‖***, Prentice Hall India.
2. Clough, Ray. W, and Penzien, Joseph (1982). ***―Dynamics of Structures‖***, McGraw Hill Company Limited, New Delhi.
3. Mario Paz, (1987). ***―Structural Dynamics‖***, CBS Publishers.
4. Chopra, A. K, (1996). ***―Dynamics of Structures‖***, Prentice Hall India.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PE 806 CE</td><td colspan="6">Design with Geosynthetics</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Theory of Structures-I</td><td>3</td><td>1</td><td>0</td><td>0</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- To understand the necessity for use of geosynthetics.
- To appreciate different types of geosythetic products and the functions served by each.
- To understand the applications of geosynthetics in various civil engineering fields.
- To learn the design of geosynthetic applications and concept of design by function.
- To understand the construction practices.

Course Outcomes

After completing this course, the student will be able to

- Understand the basic concept, manufacturing process and design process of geosynthetic.
- Comprehend different properties and test methods of geotextile.
- Describe the different properties and test methods of geogrid and geonet.
- Explain the different properties, test methods and design process of geomembranes.
- Design geo-composites for basic functions like separation, reinforcement and so on.

UNIT – I

An Overview of Geosythetics: Introduction – Classification & basic description of Geosythetics – manufacturing process – Over view of Geotextiles, Geogrids, Geonets, Geomembranes and Geocomposites.

Design Methods: Design by cost & availability – Design by specification – Design by function.

UNIT – II

Geotextile Properties and Test Methods: Physical, Mechanical, Hydraulic, Endurance and Degradation properties.

Designing With Geotextiles: Geotextile functions and mechanisms – Designing for separation – Designing for reinforcement – Designing for stabilization – Designing for filtration – Designing for drainage – designing for multi functions.

UNIT – III

Geogrid Properties and Test methods: Physical, Mechanical, Endurance and Environmental properties.

Designing with Geogrids: Designing for geogrid reinforcement

Geonets Properties and Test methods: Physical, Mechanical, Hydraulic, Endurance and Environmental properties.

Designing with Geonets: Designing for geonet drainage

UNIT – IV

Geomembrane Properties and Test methods: Physical, Mechanical, chemical, biological, thermal and Identification properties.

Designing with Geomembranes: Liquid containment liners – Covers for reservoirs – Canal liners – Landfill liners – Caps & closures – Underground storage tanks etc.

UNIT – V

Designing with Geocomposites: Geocomposites for separation – reinforcement – filtration – drainage – liquid/ vapour barriers.

Construction Methods & Techniques Using Geosynthetics.

Suggested Readings:

1. Robert, M. K. (1990). ―***Designing with Geosynthetics***.‖ Prentice Hall, Englewood Cliffs, New Jursy.
2. Venkatappa Rao, G and G.V.S.S.Raju (1990). ―***Engineering with Geosynthetics***.‖ McGraw Hill Publishing Company Ltd, New Delhi.
3. Hang, Tsang, and Fai. ―***Foundation Engineering Hand Book***.‖ CBS Publications, New Delhi.
4. Purushotham Raj. ―***Ground Improvement Techniques***.‖ Laxmi Publications, New Delhi.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PE 807 CE</td><td colspan="6">Groundwater Management</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Water Resources Engineering-I</td><td>3</td><td>0</td><td>0</td><td>0</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

To make the student familiar with the concepts of

- The importance of hydrologic cycle in improving groundwater.
- The characteristics of groundwater flow, storage parameters and geophysical methods in groundwater exploration.
- The socio-economic aspects of groundwater hydrology.
- Developing numerical solutions for groundwater flow models.

Course Outcomes

After completing this course, the student will be able to

- Describe the socio-economic aspects of groundwater hydrology.
- Perform geophysical methods for groundwater exploration.
- Compute flow from a groundwater aquifer.
- Identify groundwater contamination sources.
- Analyze various models in ground water.

UNIT – I

Introduction: Ground water in hydrologic cycle, Distribution of subsurface water, ground water potential in India and A.P, occurrence of Ground water in hydrogeologic formations, components of groundwater studies, Darcy's law and its validity. Geophysical methods in groundwater Exploration: surface geophysical methods; Electrical resistivity method, seismic method, magnetic method, determination of aquifer thickness.

UNIT – II

Governing Equations of Groundwater Flow in Aquifers: 3-D Ground water flow equations in Cartesian and polar coordinates. Equations for steady radial flow into a well in case of confined and unconfined aquifers, Equations for effect of uniform recharge in a fully penetrating unconfined aquifer, well flow near aquifer boundaries. Equations for unsteady radial flow into a well in case of confined aquifer, determination of S and T by Thei's graphical method, Cooper- Jacob's and Chow's method.

UNIT – III

Sources and Types of Groundwater Contamination: Introduction underground storage tanks, landfills, surface impoundments, waste disposal of injection wells, radioactive contaminants, classification of organic compounds, inorganic compounds in ground water. Mechanism of salt water intrusion, Ghyben-Herzberg relation , slope and shape of the interface, prevention and control of seawater intersion, case studies involving sea water intrusion.

UNIT – IV

Contaminant Transport: Introduction, advection process, diffusion and dispersion process, mass transport equation governing flow and transport equations, analytical methods, tests for dispersivity.
Non Aqueous Phase Liquids (NAPL'S): Types general processes, transport; fate of NAPL'S in subsurface.

UNIT – V

Models in Groundwater Analysis: Major applications of ground water models, sand models, viscous fluid models, membrane models, thermal models, electric-Analog models, numerical modeling of ground water systems.

Suggested Readings:

1. Rastogi, A.K. (2007). ***―Numerical Groundwater Hydrology*.‖** Penram International Publishing (India) Pvt Ltd.
2. Ven-Te-Chow. (1964). ***―Hand Book of Applied Hydrology*.‖** McGraw Hill Company, New York.
3. Todd, D.K.(1980). ***―Groundwater Hydrology*.‖** John W iley and S ons, New York.
4. Karanth, K. R. (1987). ***―Groundwater Assessment, Development And Management*.‖** Tata McGraw-Hill publishing company New Delhi.
5. Raghunath H.M (1982). ***―Ground Water*.‖** Wiley Eastern Ltd, New Delhi.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PE 808 CE</td><td colspan="6">Intelligent Transportation Systems</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Transportation Engineering</td><td>3</td><td>0</td><td>0</td><td>0</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- To introduce the concept of intelligent transportation systems.
- To understand the functional area of ITS.
- To study the ITS architecture and its applications.

Course Outcomes

- Able to plan and specification requirements using ITS
- Able to plan and management aspects for ITS
- Able to prepare architecture and application for ITS

UNIT – I

Fundamentals of Intelligent Transportation System (ITS): Basics of ITS s, The historical context of ITS from both public policy and market economic perspectives, Types of ITS; Historical Background, Benefits of ITS.

UNIT – II

Data Requirements for ITS: Importance of telecommunications in the ITS system. Information Management, Traffic management Centers (TMC). Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centers; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques - Detectors, Automatic Vehicle Location (AVL) , Automatic Vehicle Identification (AVI), GIS, data collection using videos.

UNIT – III

Functional Areas of ITS: Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation System (APTS), Advanced Rural Transportation Systems (ARTS). ITS User Needs and Services – Travel and Traffic Management, Public Transportation management, Electronic Payment, Commercial Vehicle Operations, Emergency management, Advances Vehicle safety systems, information Management.

UNIT – IV

ITS Architecture: Regional and Project ITS architecture; Concept of operations; ITS Models and Evaluation Methods; Planning and human factor issues for ITS, Case studies on deployment planning and system design and operation; ITS and Safety, and ITS Security ITS as a technology deployment program, research, development and business models/modules, ITS Planning.

UNIT – V

ITS Applications: Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road –pricing; Transportation network operations; commercial vehicle operations and intermodal freight; public transportation applications; ITS and regional strategic transportation planning, including regional architectures: ITS and changing transportation institutions Automated Highway Systems- Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the world – Overviews of ITS implementation in developed countries, IRS in developing countries.

Suggested Readings:

1. Joseph, S.S. (2008). "***Perspectives on Intelligent Transportation Systems***", Springer publishers,USA.
2. Chowdhury, M. A., Sadek, A. and Boston, M.A. (2003). "***Fundamentals of Intelligent Transportation Systems Planning",*** Artech House, -USA.
3. Kan Paul and Chen Jhon Miles (2007). "***Intelligent Transportation Systems",*** Hand Book 2000: Recommendations for World Road Association (PIARC).
4. USDT. (2007), "***National ITS Architecture Documentation***", U.S. Department of Transportation, USA.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PE 809 CE</td><td colspan="6">Prefabrication Engineering</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Project Management, Building Materials & Design of Concrete and Steel Structures</td><td>3</td><td>0</td><td>0</td><td>0</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- To understand prefabrication use in Civil Engineering.
- To understand various elements of prefabrication.
- To understand various prefabrication manufacturing aspects.

Course Outcomes

After completing this course, the student will be able to

- Understand various types of prefabrication methods.
- Analyze and eliminate erection stresses which are induced in structural elements.
- Design simple prefabricated elements and joints.
- Manage and control various steps involved in production of precast elements.
- Design and detailing of precast unit.

UNIT – I

General Principles of Prefabrication: Comparison with monolithic construction, types of prefabrication, site and plant prefabrication, economy of prefabrication, modular coordination, standardization.

UNIT – II

Prefabricated Load Carrying Members: Planning for components of prefabricated structures, disuniting of structures, design of simple rectangular beams and I-beams, handling and erection stresses, elimination of erection stresses, beams, columns, symmetric frames.

UNIT – III

Prefabricated Elements: Roof and floor panels, ribbed floor panels, wall panels, footings **Joints:** Joints for different structural connections, effective sealing of joints for water proofing, provisions for non-structural fastenings, expansion joints in precast construction.

UNIT – IV

Production Technology: Choice of production setup, manufacturing methods, stationary and mobile production, planning of production setup, storage of precast elements, dimensional tolerances, acceleration of concrete hardening.

Hoisting Technology: Equipment for hoisting and erection, techniques for erection of different types of members like beams, slabs, wall panels and columns, vacuum lifting pads.

UNIT – V

Applications: Designing and detailing of precast unit for factory structures, purlins, principal rafters, roof trusses, lattice girders, gable frames, singe span single storied simple frames, single storied buildings, slabs, beams and columns.

Suggested Readings:

1. Mokk. L, (1964), ***Prefabricated Concrete for Industrial and Public Structures***, Publishing House of the Hungarian Academy of Sciences, Budapest.

2. ***Proceedings of the Advanced Course on Design and Construction of Prefabricated Residential Buildings***, (1974), Organized by SERC, Madras.
3. Glover.C.W., (1965), ***Structural Precast Concrete***, Asia Publishing House, India.
4. Koncz. I.T., (1968), ***Manual of Precast Concrete Construction***, Vol. I, II, III & IV, Berlin.
5. Lewicki. B., (1966), ***Building with Large Prefabricates***, Elsevier Publishing Co., London.
6. Structural Design Manual – (1978), ***Precast Concrete Connection Details***, Society for the Studies in the use of Precast Concrete, Netherland Betor Verlag.
7. Murashev.V, Sigalov. E, and Bailov. V, (1968), ***Design of Reinforced Concrete Structures***, Mir Publishers.
8. CBRI, (1990), ***Building Materials and Components***, India.
9. Gerostiza. C.Z., Hendrickson. C, and Rehat. D. R, (1989), ***Knowledge Based Process Planning for Construction and Manufacturing***, Academic Press, Inc.
10. Warszawski. A, (1990), ***Industrialization and Robotics in Building*** – A Management Approach, Harper & Row.

Course Code	Course Title						Core / Elective
PE 810 CE	**Principles of Green Building Practices**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	L			
NIL	3	0	0	0	30	70	3

Course Objectives

- To impart knowledge of the principles and practices of the green buildings.
- To know the importance of sustainable use of natural resources and energy.
- To understand the principles of effective energy and resources management in buildings.
- To bring awareness of the basic criteria in the green building rating systems.
- To understand the methodologies to reduce, recycle and reuse towards sustainability.

Course Outcomes

After completing this course, the student will be able to

- Define sustainability and a green building, along with its features and benefits.
- Describe the criteria used for site selection and water efficiency methods.
- Explain the energy efficiency terms and methods used in green building practices.
- Select materials for sustainable built environment & adopt waste management methods.
- Describe the methods used to maintain indoor environmental quality.

UNIT-I

Introduction to Green Buildings: Definition of green buildings, definition of sustainability, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT- II

Site selection and planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, and so on.
Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT-III

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy.
Methods to reduce operational energy: Energy efficient building envelopes, Solar Heat Gain Coefficient, U-Values for facade materials, efficient lighting technologies, energy efficient and BEE rated appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of NET ZERO buildings.

UNIT-IV

Building materials: Methods to reduce embodied energy in building materials: (a) Local building materials. (b) Natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks. (c) Materials with recycled content such as blended cements, pozzolona cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) Reuse of waste and salvaged materials.
Waste Management: Handling of construction & demolition waste materials, separation of household waste, handling e-waste, on-site and off-site organic waste management.

UNIT-V

Indoor Environmental Quality: Day lighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics.

Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

Suggested Readings:

1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.
3. ***Alternative building materials and technologies*** by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. ***Non-Conventional Energy Resource*** by G. D. Rai, Khanna Publishers.
5. Sustainable Building Design Manual, Vol.1 and 2, TERI, New Delhi, 2004.
6. Mike Montoya, ***Green Building Fundamentals***, Pearson, USA, 2010.
7. Charles J. Kibert, ***Sustainable Construction - Green Building Design and Delivery***, John Wiley & Sons, New York, 2008.
8. Regina Leffers, ***Sustainable Construction and Design***, Pearson / Prentice Hall, USA, 2009.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PE 811 CE</td><td colspan="6">Advanced Reinforced Concrete Design</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Reinforced Cement Concrete</td><td>3</td><td>0</td><td>0</td><td>0</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- Understand the design of curved beams in plan.
- Understand the analysis and design of portal frames.
- Learn the analysis and design of an interior panel of substitute frame.
- Design flat slabs and raft slabs.

Course Outcomes

After completing this course, the student will be able to

- Design curved and deep beams.
- Design portal frames.
- Design flat slabs and raft foundations.

UNIT – I

Beams Curved in Plan: Introduction, design principles**,** structural design of beams curved in plan of circular and rectangular types, analysis of bending and torsion moments of circular beams, moments in semicircular beams supported on three columns.

Deep Beams: Introduction, flexural and shear stresses in deep beams**,** IS codal provisions, design of deep beams, detailing and design of shear walls.

UNIT-II

Portal Frames: Introduction, definition, IS codal provisions, analysis and design of rectangular portal frames for vertical loading, portal frames with hinges at the base.

UNIT – III

Building Frames: Substitute frame method of analysis for building frames, analysis and design of frames with single bay two stories and two bays single storied buildings.

UNIT – IV

Flat Slabs: Introduction, need for flat slab, general notes on flat slabs, advantages and disadvantages of flat slabs components, IS code provisions, design methods, design for flexure and shear, openings in flat slabs.

UNIT – V

Raft Foundations: Introduction to raft foundation, need for raft foundation-definitions, types, analysis and design of raft foundation for building with column grids up to three by two.

Suggested Readings:

1. Krishna Raju N, ***Advanced reinforced concrete Design***, CBS publishers, 1986.
2. Shah H. J., ***Reinforced Concrete***, Charotar publishers, 2002.
3. Varghese P.C., ***Advanced Reinforced concrete Design***, Prentice Hall of India, 2001.
4. Prakash Rao D.S., ***Design Principles and Detailing of Concrete Structures***, Tata McGraw-Hill publishing company, 1995.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PE 812 CE</td><td colspan="6">Traffic Engineering & Infrastructure Design</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>NIL</td><td>3</td><td>0</td><td>0</td><td>0</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- To provide an overview of concepts involved in geometric design of Highways, horizontal & vertical alignment of roads & pedestrian facilities.
- Identify key design elements for intersections.
- Describe usage of traffic control devices

Course Outcomes

Students who successfully complete this course will be able to:

- Understand the concepts and applications of the elements involved in Highway Infrastructure Design.
- Design intersections, bus bays, cycle tracks, subways

UNIT – I

Geometric Design of Highways: Functional classification of Highway system; Design controls - Topography, Driver characteristics, Vehicle characteristics. Traffic, Capacity and Level of Service, Design speed. Objectives of Geometric Design. Road Margins - design specifications; Pavement surface characteristics - Skid Resistance, measurement of skid resistance; Road roughness, measurement of Road roughness; Camber design and standards.

UNIT – II

Horizontal and Vertical Alignment: Sight Distance - SSD, OSD and ISD. Horizontal curves, Super elevation; computing of super elevation; attainment of super elevation; Extra widening on curves; Transition curves - Objectives and Design. Gradients - Types of Gradients, Design Standards; Summit Curves, Valley curves and Design criteria. Combination of Vertical and Horizontal curves - Grade Compensation. Importance of Sight Distances for Horizontal and Vertical curves.

UNIT – III

Design of Intersections: Types of Intersections; Design Principles for Intersections; Design At-grade Intersections – Channelisation, Objectives; Traffic Islands and Design standards Rotary Intersection - Concept, Advantages and Disadvantages; Grade separated Interchanges - Types, warrants and Design standards as per IRC.

UNIT – IV

Traffic Signs and Road Markings: Types of Road Signs; Guidelines for the provision of Road Signs; Caution Signs, Regulatory signs. Information signs - Design standards. Road markings - Objectives of Road markings; Types of Road Marking, Role of Road markings in Road Safety and Traffic Regulation; Specification for Road Marking Highway Appurtenances-Delineators, Traffic Impact Attenuators, Safety Barriers.

UNIT – V

Pedestrian Elements: Requirements of Pedestrians; Pedestrian facilities on Urban Roads; Cycle Tracks - Guidelines and Design standards; Bus bays-Types and Guide lines-Design of On street and Off street parking facilities - Guidelines for lay out Design. Design of Subways and foot over bridges.

Suggested Readings:

1. ***Principles and Practice of Highway Engineering***, L.R.Kadiyali and N.B.Lal, Khanna Publications.
2. ***Traffic Engineering and Transportation Planning***, L.R.Kadiyai, Khanna Publications
3. ***Highway Engineering***, C.E.G.Justo and S.K.Khanna, Nem Chand and Brothers
4. IRC Codes for signs***, Markings and Mixed Traffic Control in Urban Areas***.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PW 961 CE</td><td colspan="6">Project Work - II</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>NIL</td><td>0</td><td>0</td><td>0</td><td>2</td><td>50</td><td>-</td><td>1</td></tr>
</table>

Course Objectives

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes

- Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
- Evaluate different solutions based on economic and technical feasibility
- Effectively plan a project and confidently perform all aspects of project management
- Demonstrate effective written and oral communication skills

The aim of Project work –II is to implement and evaluate the proposal made as part of Project Work - I. Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

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

1. Re-grouping of students - deletion of internship candidates from groups made as part of project Work-I

2. Re-Allotment of internship students to project guides

3. Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 1st week of VIIIth semester so that students get sufficient time for completion of the project.

All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction.

Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: Three periods of contact load will be assigned to each project guide.

FACULTY OF ENGINEERING

Scheme of Instruction & Examination

(CBCS Curriculum for the Academic Year 2019-2020)

and

Syllabi

B.E. VII and VIII Semester

of

Four Year Degree Programme

In

Computer Science and Engineering

(With effect from the academic year 2019– 2020)

(As approved in the faculty meeting held on 25-06-2019)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad – 500 007

2019

SCHEME OF INSTRUCTION
BE (COMPUTER SCIENCE & ENGINEERING)
CSE: SEMESTER – VII

S.No	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		
			L	T	P/Dg	Contact	CIE	SEE	Credits
Theory Courses									
1.	PC 701 CS	Compiler Construction	3	1	-	4	30	70	3
2.	PC 702 CS	Distributed Systems	3	1	-	4	30	70	3
3.	PC 703 CS	Information Security	3	1	-	4	30	70	3
4.	PC 704 CS	Data Mining	3	1	-	4	30	70	3
5.	OE - II	Open Elective -II	3	-	-	3	30	70	3
6.	OE -III	Open Elective -III	3	-	-	3	30	70	3
Practicals/Laboratory Courses									
7.	PC 751 CS	Compiler Construction Lab	-	-	2	2	50	25	1
8.	PC 752 CS	Distributed Systems Lab	-	-	2	2	50	25	1
9.	PC 753 CS	Data Mining Lab	-	-	2	2	25	-	1
10.	PW 761 CS	Project Work - I	-	-	2	2	50	--	4
11.	PW 961 CS	Summer Internship	-	-	-	-	50	--	2
		Total	**18**	**04**	**08**	**30**	**405**	**470**	**22**

OPEN ELECTIVE-II	
OE701 CE	Green Building Technologies
OE701 CS	Database Management Systems**
OE702 EC	Fundamentals of IoT
OE701 EE	Non-Conventional Energy Sources
OE701ME	Entrepreneurship

OPEN ELECTIVE-III	
OE702 CE	Road Safety Engineering
OE703 CS	Data Science Using R Programming**
OE703 EC	Global and Regional Satellite Navigation Systems
OE702 EE	Illumination and Electric Traction systems
OE702 ME	Mechatronics

**Not offered for students of CSE Department

PC 701 CS With effect from the academic year 2019-2020

COMPILER CONSTRUCTION

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- To introduce the steps in language translation pipeline and runtime data structures used in translation
- To learn about Scanning (lexical analysis) process using regular expressions and use of LEX to generate scanner
- To introduce different Parsing strategies including top-down (e.g., recursive descent, Earley parsing, or LL) and bottom-up (e.g., backtracking or LR) techniques
- Describe semantic analyses using an attribute grammar
- To learn how to build symbol tables and generate intermediate code.
- To introduce techniques of program analysis and code optimization

Course Outcomes:

Student will be able to :

- Create lexical rules and grammars for a given language
- Generate scanners and parsers from declarative specifications.
- Describe an abstract syntax tree for a small language.
- Use program analysis techniques for code optimization
- Develop the compiler for a subset of a given language

UNIT – I

Introduction: Compilers, The translation process, Data structures and issues in compiler structure,Bootstrapping and Porting.

Scanning: The scanning process, Regular expressions, Finite Automata, Regular expressions toDFA‘s, use of LEX to generate scanner.

UNIT – II

Context Free Grammars & Parsing: The parsing process, Context free grammars, Parse tree &Abstract syntax trees, EBNF and syntax diagrams, and Properties of CFLs.

Top Down Parsing: Recursive descent parsing, LL (1) parsing, First and follow sets, Recursivedescent parser, and Error recovery in top down parsers.

UNIT – III

Bottom-up Parsing: Overview, LR (0) items and LR (0) Parsing, SLR (1) Parsing, general LR(1) andLALR(1) parsing, YACC, and Error recovery in bottom-up parsers.

UNIT – IV

Semantic Analysis: Attributes and attribute grammars, Algorithms for attribute computation, Symboltable, Data types and Type checking.

Runtime Environments: Memory organization during program execution, Fully static runtimeenvironments, Stack-based runtime environments, Dynamic memory, and Parameter parsing mechanisms.

UNIT – V

Code Generation: Intermediate code and data structures for code generation, Basic code generationtechniques, Code generation of data structure references, Code generation of control statements and logical expressions, Code generation of procedure and function calls, Code generation in commercial compilers, Code optimization techniques, and Data flow equation.

Suggested Readings:

1. Kenneth C. Louden, ―*Compiler Construction: Principles and Practice*‖, Thomson Learning Inc., 1997.
2. Ravi Sethi, Aho& Ullman JP, ―*Compilers: Principles, Techniques and Tools*‖, Addison Wesley publishing co., 1986.
3. J.P. Tremblay and P.S. Sorenson, ―*The Theory and Practice of Compiler Writing*‖, TMH-1985.

PC 702 CS With effect from the academic year 2019-2020

DISTRIBUTED SYSTEMS

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- To acquire an understanding of the issues in distributed systems
- To study architectures and working of distributed file systems
- To expose the students to distributed transaction management, security issues and replication

Course Outcomes:

Student will be able to :

- Describe the problems and challenges associated with distributed systems.
- Implement small scale distributed systems .
- Understand design tradeoffs in large-scale distributed systems

UNIT-I

Introduction: Goals and Types of Distributed Systems

Architectures: Architectural Styles, System Architectures, Architectures versus Middleware, andSelf-Management in Distributed Systems.

Processes: Threads, Virtualization, Clients, Servers, and Code Migration.

Communication: Fundamentals, Remote Procedure Call, Message-Oriented Communication, Stream-Oriented Communication, and Multicast Communication.

UNIT-II

Naming: Names, Identifiers and Addresses, Flat Naming, Structured Naming, and Attribute-BasedNaming.

Synchronization: Clock Synchronization, Logical Clocks, Mutual Exclusion, Global Positioning ofNodes, and Election Algorithms.

Consistency and Replication: Introduction, Data-Centric Consistency Models, Client-CentricConsistency Models, Replica Management, and Consistency Protocols.

UNIT-III

Fault Tolerance: Introduction to Fault Tolerance, Process Resilience, Reliable Client-ServerCommunication, Reliable Group Communication, Distributed Commit, and Recovery.

Distributed Object-Based Systems: Architecture, Processes, Communication, Naming,Synchronization, Consistency and Replication, Fault Tolerance, and Security.

UNIT-IV

Distributed File Systems: Architecture, Processes, Communication, Naming, Synchronization,Consistency and Replication, Fault Tolerance, and Security.

Distributed Web-Based Systems: Architecture, Processes, Communication, Naming,Synchronization, Consistency and Replication, Fault Tolerance, and Security.

UNIT-V

Distributed Coordination-Based Systems: Introduction to Coordination Models, Architecture,Processes, Communication, Naming, Synchronization, Consistency and Replication, Fault Tolerance, and Security.

Map-Reduce: Example, Scaling, programming model, Apache Hadoop, Amazon Elastic Map Reduce,Mapreduce.net, Pig and Hive.

Suggested Readings:

1. Andrew S. Tanenbaum and Maarten Van Steen, ―*Distributed Systems*‖, PHI 2nd Edition, 2009.
2. R.Hill, L.Hirsch, P.Lake, S.Moshiri, ―*Guide to Cloud Computing*, Principles and Practice‖, Springer, 2013.
3. R.Buyya, J.Borberg, A.Goscinski,‖*Cloud Computing-Principles and Paradigms*‖,Wiley 2013.

PC 703 CS With effect from the academic year 2019-2020

INFORMATION SECURITY

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University 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:

Student will be able to:
- Describe the steps in Security Systems development life cycle(SecSDLC)
- Understand the common threats and attack to information systems
- Understand the legal and ethical issues of information technology
- Identify security needs using risk management and choose the appropriate risk control strategy based on business needs
- Use the basic knowledge of security frameworks in preparing security blue print for the organization
- 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
- Use ethical hacking tools to study attack patterns and cryptography and secure communication protocols
- 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, SecurityEducation, Continuity strategies.
Security Technology: Firewalls and VPNs: Physical Design, Firewalls, Protecting Remoteconnections.

UNIT-IV

Security Technology: Intrusion Detection, Access Control, and other Security Tools: IntrusionDetection 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 ofimplementation, Non Technical Aspects of implementation, Security Certification and Accreditation. **Security and Personnel:** Positioning and staffing security function, Employment Policies andPractices, and Internal control Strategies.
Information Security Maintenance: Security management models, Maintenance model, and DigitalForensics.

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

PE 704 CS *With effect from the academic year 2019-2020*

DATA MINING

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:
- To introduce the basic concepts of data Mining and its applications
- To understand different data mining like classification, clustering and Frequent Pattern mining
- To introduce current trends in data mining

Course Outcomes:

Student will be able to:
- Organize and Prepare the data needed for data mining using prepreprocessing techniques
- Implement the appropriate data mining methods like classification, clustering or Frequent Pattern mining on a given data set
- Define and apply metrics to measure the performance of various data mining algorithms

UNIT-I

Introduction: Why Data Mining? What is Data Mining? What kinds of data can be mined? Whatkinds of patterns can be mined? Which technologies are used ? Which kinds of applications are Targeted? Major issues in Data Mining. Getting to know your data: Data objects and attributed types. Basic statistical descriptions of data. Data visualization, Measuring data similarity and dissimilarity.

UNIT-II

Mining frequent patterns, Associations and correlations: Basic concepts and methods, FrequentItem set Mining Methods, Which patterns are interesting? Pattern evaluation methods.

UNIT-III

Classification : Basic concepts, Decision tree induction, Bayes classification methods,

Classification: Advance methods, Bayesian Belief Network, Classification by back propagation,Support vector machine,

UNIT-IV

Cluster Analysis: Concepts and Methods: Cluster Analysis, Partitioning Methods, HierarchicalMethods, Density-Based Methods, Grid-Based Methods, Evaluation of clustering.

UNIT-V

Data Mining Trends and Research Frontiers: Mining Complex Data Types, Other Methodologiesof Data Mining, Data Mining Applications, Data Mining and Society, Data Mining trends.

Suggested Readings:

1. Jiawei Han, MichelineKamber, Jin Pei, Data Mining: Concepts & Techniques, 3rd Edition., MorgonKoffman ,2011
2. VikramPudiP.Radha Krishna, *Data Mining*, Oxford University Press, 1st Edition, 2009.
3. Pang-Ning Tan, Michael Steinbach, Vipinkumar, *Introduction to Data Mining,* Pearson Education, 2008.

PC 751 CS *With effect from the academic year 2019-2020*

COMPILER CONSTRUCTION LAB

Instruction	2 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	1

Course Objectives:

- To learn usage of tools LEX, YAAC
- To develop a code generator
- To implement different code optimization schemes

Course Outcomes:

Student will be able to:

- To Generate scanner and parser from formal specification
- To design a compiler for a subset of any High level language

1. Construction of DFA from NFA
2. Scanner program using LEX
3. Construction of a Predictive parsing Table
4. SLR Parser table generation
5. Implement unification Algorithm
6. LR Parser table generation
7. Parser Generation using YACC
8. Write a program on code generation
9. Write a program on code optimization

PC 752 CS *With effect from the academic year 2019-2020*

DISTRIBUTED SYSTEMS LAB

Instruction	2 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	1

Course Objectives:

- To implement client and server programs using sockets
- To learn about working of NFS
- To use Map Reduce model for distributed processing
- To develop mobile applications

Course Outcomes:

Student will be able to :

- Write programs that communicate data between two hosts
- Configure NFS
- Use distributed data processing frameworks and mobile application tool kits

1. Implementation FTP Client
2. Implementation of Name Server
3. Implementation of Chat Server
4. Understanding of working of NFS (Includes exercises on Configuration of NFS)
5. Implementation of Bulletin Board.
6. Implement a word count application which counts the number of occurrences of each word a large collection of documents Using Map Reduce model.
7. Develop an application (small game-like scrabble, Tic-tac-Toe) using Android SDK.

PC 753 CS *With effect from the academic year 2019-2020*

DATA MINING LAB

Instruction	2	Periods per week
Duration of University Examination	3	Hours
University Examination	50 Marks	
Sessionals	25 Marks	
Credits	1	

PW 761 CS *With effect from the academic year 2019-2020*

PROJECT WORK –I

Instruction	2 Periods per week
Sessional	50 Marks
Credit	2

Course Objectives:

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic Literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes:

Student will be able to :

- Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
- Evaluate different solutions based on economic and technical feasibility
- Effectively plan a project and confidently perform all aspects of project management
- Demonstrate effective written and oral communication skills

The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester.

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

Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries)

Grouping of students (max 3 in a group)

Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses , new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide.

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

Each group will be required to:

1. Submit a one page synopsis before the seminar for display on notice board.
2. Give a 30 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

*Problem definition and specification

*Literature survey

*Broad knowledge of available techniques to solve a particular problem.

*Planning of the work, preparation of bar (activity) charts

*Presentation- oral and written.

PW 961 CS *With effect from the academic year 2019-2020*

SUMMER INTERNSHIP

University Examination	50 Marks
Credits	2

Course Objectives:

- To train and provide hands-on experience in analysis, design, and programming of information systems by means of case studies and projects.
- To expose the students to industry practices and team work.
- To provide training in soft skills and also train them in presenting seminars and technical report writing.

Course Outcomes:
Student will be able to :

- Get Practical experience of software design and development, and coding practices within Industrial/R&D Environments.
- Gain working practices within Industrial/R&D Environments.
- Prepare reports and other relevant documentation.

Summer Internship is introduced as part of the curricula of encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Computer Industry/Software Companies/R&D Organization for a period of 8 weeks. This will be during the summer vacation following the completion of the III year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry co-ordinate (person from industry).

After the completion of the project, student will submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the Department. Award of sessionals are to be based on the performance of the students, to be judged by a committee constituted by the department. One faculty member will co-ordinate the overall activity of Industry Attachment Program.

SCHEME OF INSTRUCTION

BE (COMPUTER SCIENCE & ENGINEERING)

SEMESTER – VIII

S.No	Course Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
Theory									
1.	PE-III	Professional Elective-III	3	1	0	4	30	70	3
2.	PE-IV	Professional Elective-IV	3	1	0	4	30	70	3
3.	PE-V	Professional Elective-V	3	1	0	4	30	70	3
Practicals									
4	PW861CS	Project Work –II	0	0	4	4	50	100	8
		Total	**09**	**03**	**07**	**19**	**190**	**310**	**17**

ProfessionalElective-III:		
S.No	Course Code	Course Title
1	PE 801 CS	Mobile Computing
2	PE 802 CS	Image Processing
3	PE 803 CS	Software Quality & Testing
4	PE 804 CS	Web services and Architecture
5	PE 805 CS	Computational Intelligence

ProfessionalElective-IV		
S.No	Course Code	Course Title
1	PE 806 CS	Embedded Systems
2	PE 807 CS	Information Retrieval
3	PE 808 CS	Machine Learning
4	PE 809 CS	Natural Language Processing
5	PE 810 CS	Data Science Using R

ProfessionalElective-V		
S.No	Course Code	Course Title
1	PE 811 CS	Multi Core & GPU programming
2	PE 812 CS	Cloud Computing
3	PE 813 CS	Human Computer Interaction

PE 801 CS *With effect from the academic year 2019-2020*

MOBILE COMPUTING
(PROFESSIONAL ELECTIVE-III)

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- To introduce basics of wireless voice and data communication technologies
- To build working knowledge on various telephone and satellite networks
- To study the working principles of wireless LANs and standards
- To study principles of adhoc networks and routing
- To gain knowledge on integration of mobile networks into Internet
- To build skills in working with wireless application protocols to develop mobile applications.

Course Outcomes:

Students will be able to

- Implement Adhoc Network Routing protocols.
- Mini based project based on tracking, localization and routing in wireless networks.
- Implement file transfer, access and authentication based applications for mobile computing.

UNIT I

Introduction – Wireless transmission – Frequencies for radio transmission – Signals – Antennas – Signal Propagation – Multiplexing – Modulations – Spread spectrum – MAC – SDMA – FDMA – TDMA – CDMA – Cellular Wireless Networks.

UNIT II

Telecommunication systems – GSM – GPRS – DECT – UMTS – IMT-2000 – Satellite Networks - Basics – Parameters and Configurations – Capacity Allocation – FAMA and DAMA – Broadcast Systems – DAB - DVB.

UNIT III

Wireless LAN – IEEE 802.11 - Architecture – services – MAC – Physical layer – IEEE 802.11a - 802.11b standards – HIPERLAN – Blue Tooth.

UNIT IV

Mobile IP, Dynamic Host Configuration Protocol, Routing in MANETs: DSDV, DSR, AODV and ZRP. MANETS vs VANETs.

UNIT V

Traditional TCP – classical TCP improvements – WAP, and WAP 2.0.

Mobile Transaction models, File Systems and Mobility Management

Suggested Readings:

1. Jochen H. Schiller, ―*Mobile Communications*‖, Addison Wesley, Second Edition, 2003(Unit I Chap 1,2 &3- Unit II chap 4,5 &6-Unit III Chap 7.Unit IV Chap 8- Unit V Chap 9&10.)
2. William Stallings, ―*Wireless Communications and Networks*‖, PHI/Pearson Education, 2002(Unit I Chapter – 7&10-Unit II Chap 9)
3. KavehPahlavan, Prasanth Krishnamurthy, ―*Principles of Wireless Networks*‖, Prentice Hall, 2003.
4. Uwe Hansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, ―*Principles of MobileComputing*‖, Springer, 2003.
5. Krzysztof Wesolowski, ―*Mobile Communication Systems*‖, John Wiley and Sons Ltd, 2002.

PE 802 CS *With effect from the academic year 2019-2020*

IMAGE PROCESSING
(PROFESSIONAL ELECTIVE-III)

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives

- To introduce basics of visual perception, sampling, quantization and representation of digital images
- To introduce spatial domain and frequency domain filtering techniques necessary for image processing operations.
- To learn advanced image analysis techniques such as image compression, image segmentation, and object recognition
- To learn techniques of color image processing, multi resolution methods, wavelets and morphological processing

Course Outcomes

Student will be able to :

- Analyze images in the frequency domain using various transforms
- Design and implement algorithms that perform image processing operations such as histogram equalization, enhancement, restoration , filtering and denoising
- Explain color spaces , restoration and enhancement of color images
- Develop simple object recognition systems

UNIT I

Image Processing: Introduction, Examples, Fundamental steps, Components, Elements of visualperception, Light and Electromagnetic Spectrum, Image sensing and Acquisition, Image Sampling and Quantization, Basic relationships between pixels.

Intensity Transformations and Spatial Filtering: Background, Some basic intensity transformationfunctions, Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters, Combining Spatial Enhancement Methods.

UNIT II

Filtering in the Frequency Domain: Background, Preliminary concepts, Sampling and FourierTransform of Sampled Functions, Discrete Fourier Transform (DFT) of one variable, Extension to functions of two variables, Some Properties of the 2-D Discrete Fourier Transform, Basics of Filtering in the Frequency Domain, Image Smoothing, Image Sharpening, Homomorphic Filtering.

Image Restoration: Noise Models, Restoration in the presence of noise only-Spatial Filtering,Periodic Noise Reduction by Frequency Domain Filtering.
Linear Degradation, Position-invariant Degradation, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error Filtering, Constrained Least Squares Filtering, Geometric Mean Filter.

UNIT III

Color Image Processing: Color fundamentals, Color models, Pseudocolor Image Processing, Basicsof Full-color Image Processing, Color Transformations, Smoothing and Sharpening, Color-based Image Segmentation, Noise in Color Images, Color Image Compression.

Wavelets and Multi resolution Processing: Background, Multiresolution Expansions, WaveletTransforms in One Dimension, The Fast Wavelet Transform, Wavelet Transforms in Two Dimensions, Wavelet Packets.

UNIT IV

Image Compression: Fundamentals, Image Compression Models, Elements of Information Theory,Error- free Compression, Lossy Compression, Image Compression Standards, Some Basic Compression Methods.

Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, TheHit-or-Miss Transformation, Some Basic Morphological Algorithms, Some Basic Gray-Scale Morphological Algorithms.

UNIT V

Image Segmentation: Fundamentals, Point, Line and Edge Detection, Thresholding, Region-basedSegmentation, Segmentation using Morphological Watersheds, The use of Motion in Segmentation.

Object Recognition: Patterns and Pattern Classes, Recognition based on Decision-theoretic Methods,Structural Methods.

Suggested Readings:

1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing,* PHI Learning Pvt. Limited, 3rd Edition, 2008.
2. William K. Pratt, *Digital Image Processing*, John Wiley & Sons, Inc., 3rd Edition, 2001.

PE 803 CS *With effect from the academic year 2019-2020*

SOFTWARE QUALITY AND TESTING

(PROFESSIONAL ELECTIVE-III)

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- To understand the challenges of Software Quality and the need for integration of quality activities in project life cycle
- To introduce supporting software quality devices
- To introduce software quality metrics and Quality Assurance models
- To understand the steps in software testing process and taxonomy of testing tools

.
Course Outcomes:

Student will be able to :

- Describe the role of quality assurance activities in the software process
- Compare several process improvement models such as CMM, CMMI, PCMM, and ISO9000
- Describe several process metrics for assessing and controlling a project
- Describe how available static and dynamic test tools can be integrated into the software development environment

UNIT - I

The Software Quality Challenge, Introduction Software Quality Factors, The Components of the Software Quality Assurance System – Overview, Development and Quality Plans.

UNIT - II

Integrating Quality Activities in the Project Life Cycle, Assuring the Quality of Software Maintenance Components, CASE Tools and their effect on Software Quality, Procedure and Work Instructions, Supporting Quality Devices, Configuration Management, Documentation Control, Project Progress Control.

UNIT - III

Software Quality Metrics, Costs of Software Quality, Quality Management Standards - ISO 9000 and Companion ISO Standards, CMM, CMMI, PCMM, Malcom Balridge, 3 Sigma, 6 Sigma, SQA Project Process Standards – IEEE Software Engineering Standards.

UNIT - IV

Building a Software Testing Strategy, Establishing a Software Testing Methodology, Determining Your Software Testing Techniques, Eleven – Step Software Testing Process Overview, Assess Project Management Development Estimate and Status, Develop Test Plan, Requirements Phase Testing, Design Phase Testing, Program Phase Testing, Execute Test and Record Results, Acceptance Test, Report Test Results, Test Software Changes, Evaluate Test Effectiveness.

UNIT - V

Testing Client / Server Systems, Testing the Adequacy of System Documentation, Testing Web-based Systems, Testing Off – the – Shelf Software, Testing in a Multiplatform Environment, Testing Security, Testing a Data Warehouse, Creating Test Documentation, Software Testing Tools, Taxonomy of Testing Tools, Methodology to Evaluate Automated Testing Tools, Load Runner, Win Runner and Rational Testing Tools, Java Testing Tools, JMetra, JUNIT and Cactus.

Suggested Readings:

1. Daniel Galin, *Software Quality Assurance–From Theory to Implementation*, Pearson Education.2004
2. Mordechai Ben – Menachem / Garry S.Marliss, *Software Quality–Producing Practical, ConsistentSoftware*, BS Publications, 2014
3. William E. Perry, *Effective Methods for Software Testing*, 2nd Edition, Wiley .
4. Srinivasan Desikan, Gopalaswamy Ramesh, *Software Testing, Principles and Practices*, 2006. Pearson Education.
5. Dr.K.V.K.K. Prasad, *Software Testing Tool*, Wiley Publishers

Web Resources :

1. http://www.sei.cmu.edu/cmmi/
2. www.ibm.com/software/awdtools/tester/functional/index.html
3. www.ibm.com/software/awdtools/test/manager/
4. *java-source.net/open-source/testing-tools*
5. www.junit.org
6. *java-source.net/open-source/web-testing-tools*

PE 804 CS *With effect from the academic year 2019-2020*

WEB SERVICES AND ARCHITECTURE
(PROFESSIONAL ELECTIVE-III)

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives

- To study the evolution of SOA and Web Services
- To understand the principles of service orientation , Service layers
- To learn about WS* Specifications , messaging with SOAP and Service composition
- To learn about service oriented analysis and service oriented design
- Gained knowledge on various open standards available for developing SOA compliant web services

Course Outcomes:

Student will be able to :

- Understand web service framework with respect to SOA
- Develop SOA compliant web services using open standards and various technologies
- Model and implement businesses processes using service oriented approach

UNIT- I :
SOA and Web Services Fundamentals: Introducing So, The Evolution of SOA, Web services and primitive SOA.

UNIT-II:
SOA and WS-*Extensions: Web Services and Contemporary SOA(I: Activity Management and Composition), Web Services and Contemporary SOA(II: Advanced Messaging, Metadata, and Security).

UNIT-III:
SOA and Service-Orientation: Principles of Service-Orientation, Service Layers.

UNIT-IV:
Building SOA (Planning And Analysis) : SOA Delivery Strategies, Services-Oriented Analysis (I: Introduction), Service-Oriented Analysis (II: Service Modeling).

UNIT-V:
Building SOA (Technology And Design): Service-Oriented Design (I: Introduction), Service-Oriented Design (II: SOA Composition Guidelines), Service-Oriented Design (III: Service-Design), Service-oriented Design (IV: Business Process Design), Fundamentals WS-*Extensions, SOA Platforms.

Suggested Readings

1. Thomas Eri*,"Service-Oriented Architecture(SOA): Concepts, Technology, and Design*‖, Prentice Hall PTR, 2005
2. James McGovern and Sameer Tyagi , ―*Java Web Services Architecture*,‖, Morgan Kaufmann- May 2003.

PE 805 CS *With effect from the academic year 2019-2020*

COMPUTATIONAL INTELLIGENCE
(PROFESSIONAL ELECTIVE-III)

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objective:

- To introduce the concepts of Biological and Artificial neural networks
- To understand different neural architectures with supervised learning and their learning mechanisms
- To study different neural architectures with unsupervised learning such as PCA Networks ,Kohenen‘s Self-Organizing Maps
- To introduce Markov decision processes , Q-Learning and TD-Learning
- To study different models of evolution and learning, neuro-fuzzy techniques, rough set theory and their applications

Course Outcomes:

Student will be able to :

- Design single and multi-layer feed-forward neural networks
- Implement various unsupervised learning networks
- Design new evolutionary operators , representations and fitness functions for specific practical problems
- Apply fuzzy logic and rough sets to handle uncertainty and vagueness in practical problems

UNIT -I

Introduction to Computational Intelligence / Soft computing: Soft versus Hard Computing,Various paradigms of computing

Foundations of Biological Neural Networks: Introduction to Neural Networks, Humans andComputers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN (Learning, Generalization, Memory, Abstraction, Applications), McCulloch-Pitts Model, Historical Developments

Essentials of Artificial Neural Networks: Introduction, Artificial Neuron Model, Operations ofArtificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity (Feed forward, feedback, Single and Multi-layer), Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules (Error Correction, Hebbian, Competitive, Stochastic), Types of Application (Pattern

Classification, Pattern Clustering, Pattern Association / Memory, Function Approximation, Prediction, Optimization)

UNIT –II

Neural Architectures with Supervised Learning: Single Layer Feed Forward Neural Networks(Perception), Multilayer Feed forward Neural Networks (Back propagation learning), Radial Basis Function Networks, Support Vector Machines, Simulated Annealing, Boltzmann Machine, Feedback (Recurrent) Networks and Dynamical Systems

Associative Memories: Matrix memories, Bidirectional Associative Memory, Hopfield NeuralNetwork,

UNIT –III

Neural Architectures with Unsupervised Learning: Competitive learning, Principal ComponentAnalysis Networks (PCA), Kohonen‘s Self-Organizing Maps, Linear Vector Quantization, Adaptive Resonance Theory (ART) Networks, Independent Component Analysis Networks (ICA)

UNIT -IV

Reinforcement Learning: Markov Decision Processes, Value Functions, Bellman OptimalityCriterion, Policy and Value Iterations, Q-Learning, TD Learning

UNIT -V

Fuzzy Logic: Basic concepts, fuzzy set theory, basic operations, fuzzification, defuzzification,neurofuzzy approach, applications

Evolutionary and Genetic Algorithms: Basic concepts of evolutionary computing, genetic operators,fitness function and selection, genetic programming, other models of evolution and learning, ant colony systems, swarm intelligence, applications

Rough Set Theory: Basic concepts, indiscernability relation, lower and upper approximation,decision systems based on rough approximation, applications

Suggested Readings:

1. Jacek M. Zurada. Introduction to Artificial Neural Systems, Jaico Publishers, 1992.
2. S. Haykin. Neural Networks: A Comprehensive Foundation, Prentice Hall, 1999
3. P. S. Churchland and T. J. Sejnowski. The Computational Brain. MIT Press, 1992.
4. A. M. Ibrahim. Introduction to Applied Fuzzy Electronics. PHI, 2004
5. Z. Pawlak. Rough Sets, Kluwer Academic Publishers, 1991.

PC 806 CS With effect from the academic year 2019-2020

EMBEDDED SYSTEM
(PROFESSIONAL ELECTIVE-IV)

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives :
- To provide basics of embedded systems design and development flow.
- To study the processor architectures that supports embedded systems.
- To gain knowledge developing platforms for embedded systems.
- To provide basics of real time operating systems that supports embedded systems.
- To study the concepts on testing and development tools.

Course Outcomes :

Student will be able to :
- Understand the basics of embedded systems design and development flow.
- Apply knowledge to develop the embedded systems.
- Analyse the real time operating that supports embedded systems.

UNIT- I

Design of Embedded System: Sensors and Actuators, Embedded Processors, Memory Architectures,Input and Output.

UNIT –II

Embedded Systems development Environment: IDE, Cross compilation, Disassembler, Simulators,Emulators and Debugging, Target hardware debugging, Boundary Scan.

Embedded Computing Platform: Programming for Embedded systems using C, Device drivers, program modeling concepts, Process of Embedded system development: embedded software development on microcontroller platform, network-based embedded applications and embedded control applications.

UNIT-III

Embedded C Programming: Review of data types - Scalar types-Primitive types-Enumerated types-Subranges, Structure types-character strings -arrays- Functions. Interfacing C with Assembly. Embedded programming issues - Reentrancy, Portability, Optimizing, and testing embedded C programs.

UNIT- IV

Concept of Embedded Operating Systems, Differences between Traditional OS and RTOS. Real-time System Concepts, RTOS Kernel & Issues in Multitasking – Task Assignment, Task Priorities, Scheduling, Intertask Communication & Synchronization – Definition of Context Switching, Foreground ISRs and Background Tasks. Critical Section – Reentrant Functions, Interprocess Communication (IPC) – IPC through Semaphores, Mutex, Mailboxes, Message Queues or Pipes and Event Flags.

UNIT –V

VxWorks – POSIX Real Time Extensions, timeout features, Task Creation, Semaphores (Binary, Counting), Mutex, Mailbox, Message Queues, Memory Management – Virtual to Physical Address Mapping.

Suggested Readings:

1. Edward Ashford Lee and SanjitArunkumarSeshia, ―Introduction to Embedded Systems- A cyber-Physiacal Systems Approach, Second Edition, MIT Press, 2017.
2. Jones, M Tim*, GNU/Linux Application Programming*, 2nd Edition, Course Technology PTR, 2008.
3. Raj Kamal, ― Embedded systems Architecture, programming & Design‖, Tata McGraw Hill, 2010.
4. Real Time Systems, C.M.Krishna and G.Shin, McGraw-Hill Companies Inc., McGraw Hill International Edition, 1997.
5. Programming Embedded Systems with C and GNU Development Tools, Second Edition, 1977.

PE 807 CS *With effect from the academic year 2019-2020*

INFORMATION RETRIEVAL SYSTEMS

(PROFESSIONAL ELECTIVE-IV)

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- To understand indexing and querying in information retrieval systems
- To learn the different models for information retrieval
- To expose the students to text classification and clustering
- To learn about web searching

Course Outcomes:

Students will be able to :

- Understand the algorithms and techniques for information retrieval (document indexing and retrieval, query processing)
- Quantitatively evaluate information retrieval systems
- Classify and cluster documents
- Understand the practical aspects of information retrieval such as those in web search engines.

UNIT-I

Boolean Retrieval: An example information, Building an inverted index, Processing Boolean queries,The extended Boolean model versus ranked retrieval.

The term vocabulary and postings lists: Document delineation and character sequence decoding,determining the vocabulary of terms, Faster postings list intersection via skip pointers, Positional postings, and Phrase queries.

Dictionaries and tolerant retrieval: Search structures for dictionaries, Wildcard queries, Spellingcorrection.

Index construction: Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing,Distributed indexing, Dynamic indexing, Other types of indexes.

UNIT-II

Index compression: Statistical properties of terms in information retrieval, Dictionary compression,Postings file compression.

Scoring, term weighting and the vector space model: Parametric and zone indexes, Term frequencyand weighting, The vector space model for scoring, and Variant tf-idf functions.

Computing scores in a complete search system: Efficient scoring and ranking, Components of aninformation retrieval system, Vector space scoring and query operator interaction.

Evaluation in information retrieval: Information retrieval system evaluation, Standard testcollections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance.

UNIT-III

Relevance feedback and query expansion: Relevance feedback and pseudo relevance feedback,Global methods for query reformulation.

XML retrieval: Basic XML concepts, Challenges in XML retrieval, A vector space model for XMLretrieval, Evaluation of XML retrieval, Text-centric vs. data-centric XML retrieval.

Probabilistic information retrieval: Basic probability theory, The Probability Ranking Principle,The Binary Independence Model.

Language models for information retrieval: Language models, The query likelihood model.

UNIT-IV

Text classification and Naive Bayes: The text classification problem, Naive Bayes text classification,The Bernoulli model, Properties of Naive Bayes, and Feature selection.

Vector space classification: Document representations and measures of relatedness in vector spaces,Rocchio classification, k- nearest neighbor, Linear versus nonlinear classifiers.

Flat clustering: Clustering in information retrieval, Problem statement, Evaluation of clustering, k-means.

Hierarchical clustering: Hierarchical agglomerative clustering, Single-link and complete-linkclustering, Group-average agglomerative clustering, Centroid clustering, Divisive clustering.

UNIT-V

Matrix decompositions and Latent semantic indexing: Linear algebra review, Term-documentmatrices and singular value decompositions, Low-rank approximations, Latent semantic indexing.

Web search basics: Background and history, Web characteristics, Advertising as the economicmodel, The search user experience, Index size and estimation, Near-duplicates and shingling.

Web crawling and Indexes: Overview, Crawling, Distributing indexes, Connectivity servers.
Link analysis: The Web as a graph, Page Rank, Hubs and Authorities.

Suggested Readings:

1. Christopher D. Manning, PrabhakarRaghavan, HinrichSchütze, *An Introduction to InformationRetrieval*, Cambridge University Press, Cambridge, England, 2008
2. David A. Grossman, Ophir Frieder, *Information Retrieval–Algorithms and Heuristics*, Springer, 2nd Edition (Distributed by Universities Press), 2004.
3. Gerald J Kowalski, Mark T Maybury. *Information Storage and Retrieval Systems*, Springer, 2000
4. SoumenChakrabarti, *Mining the Web: Discovering Knowledge f romHypertextData* , Morgan-Kaufmann Publishers, 2002.

PE 808 CS *With effect from the academic year 2019-2020*

MACHINE LEARNING
(PROFESSIONAL ELECTIVE-IV)

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course objectives:

- To introduce the basic concepts of machine learning and range of problems that can be handled by machine learning
- To introduce the concepts of instance based learning and decision tree induction
- To introduce the concepts of linear separability , Perceptron and SVM
- To learn the concepts of probabilistic inference, graphical models and evolutionary learning
- To learn the concepts of ensemble learning, dimensionality reduction and clustering

Course Outcomes:

Student will be able to :

- Explain the strengths and weaknesses of many popular machine learing approaches
- Recognize and implement various ways of selecting suitable model parameters for different machine learning techniques
- Design and implement various machine learning algorithms in a range of real-world applications

UNIT-I

Introduction: Learning, Types of Machine Learning.
Concept learning: Introduction, Version Spaces and the Candidate Elimination Algorithm. **Learning with Trees:** Constructing Decision Trees, CART, Classification Example

UNIT-II

Linear Discriminants: The Perceptron, Linear Separability, Linear Regression
Multilayer Perceptron (MLP): Going Forwards, Backwards, MLP in practices, Deriving back **Propagation SUPPORT Vector Machines**: Optimal Separation, Kernels

UNIT-III

Some Basic Statistics: Averages, Variance and Covariance, The Gaussian, The Bias-VarianceTradeoff Bayesian learning: Introduction, Bayes theorem. Bayes Optimal Classifier, Naive Bayes Classifier.

Graphical Models: Bayesian networks, Approximate Inference, Making Bayesian Networks, HiddenMarkov Models, The Forward Algorithm.

UNIT-IV

Evolutionary Learning: Genetic Algorithms, Genetic Operators, Genetic Programming **Ensemble learning:** Boosting, Bagging

Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis

UNIT-V

Clustering: Introduction, Similarity and Distance Measures, Outliers, Hierarchical Methods,Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes, Comparison

Suggested Readings:

1. Tom M. Mitchell, *Machine Learning*, Mc Graw Hill, 1997
2. Stephen Marsland, *Machine Learning - An Algorithmic Perspective*, CRC Press, 2009
3. Margaret H Dunham, *Data Mining*, Pearson Edition., 2003.
4. GalitShmueli, Nitin R Patel, Peter C Bruce, *Data Mining for Business Intelligence*, Wiley India Edition, 2007
5. RajjanShinghal, *Pattern Recognition*, Oxford University Press, 2006.

PE 809 CS *With effect from the academic year 2019-2020*

NATURAL LANGUAGE PROCESSING
(PROFESSIONAL ELECTIVE-IV)

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:
- To learn about corpus-based work collections
- To understand the models and methods of Statistical NLP
- To introduce IR and ML based techniques for NLP tasks

Course Outcomes:
Student will be able to :

- Impalement probabilistic models and estimate parameters for such models
- Gain understanding of linguistic phenomenon and will explore linguistic features relevant to each NLP task
- Apply the methods to new NLP problems and also to problems outside NLP

UNIT-I

Introduction of Elementary Probability Theory, Essential Information Theory

UNIT-II

Linguistic Essentials Corpus-Based Work Collocations.

UNIT-III

Statistical Inference: Bins: Forming Equivalence Classes, Reliability vs. Discrimination, n-grammodels, Building n-gram models, An Information Theoretic Approach.
Word Sense Disambiguation: Methodological Preliminaries, Supervised and unsupervised learning,Pseudo words, Upper and lower bounds on performance, Supervised Disambiguation, Bayesian classification.

UNIT-IV

Evaluation Measures, Markov Models: Hidden Markov Models, Use, General form of an HMMPart-of-Speech Tagging

UNIT-V

Probabilistic Context Free Grammars: Introduction of Clustering **Information Retrieval:** Background, The Vector Space Model.

Suggested Readings:

1. Christopher D. Manning, HinrichSchutze, *Foundations of Statistical Natural LanguageProcessing,* MIT Press, 1999.
2. James Allan, *Natural Language Understanding*, Pearson Education, 1994.
3. Tanveer Siddiqui, US Tiwary, *Natural Language Processing and Information Retrieval,* Oxford University Press, 2008.

PE 810 CS *With effect from the academic year 2019-2020*

DATA SCIENCE USING R
(PROFESSIONAL ELECTIVE-IV)

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

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

Course Outcomes:

Student will be able to :

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

UNIT-I

Introduction To R: Introduction, Downloading and Installing R, IDE and Text Editors, HandlingPackages in R.

Getting Started With R: Introduction, Working with Directory, Data Types In R, Few Commands forData 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 DataFrames, 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 LinearRegression, 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, DecomposingTime 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 AlgorithmInterfaces, Auxiliary Functions, Sampling from Transaction, Generating Synthetic Transaction Data, Additional Measures of Interestingness, Distance Based Clustering Transaction and Association.

Text Mining: Introduction, Definition of Text Mining, A Few Challenges in Text Mining, TextMining 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 ItemsetAnd Association Rules.
Frequent Itemset: Mining Methods, Pattern Evaluation Methods, Sentiment Analysis

Suggested Readings:

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

PE 811 CS *With effect from the academic year 2019-2020*

MULTI-CORE & GPU PROGRAMMING

(PROFESSIONAL ELECTIVE-V)

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives

- To learn the paradigms of parallel computing, PRAM and BSP model.
- To study the heterogeneous processor architectures
- To understand the multicore programming using OpenCL
- To provide basics of OpenCL computing models

Course Outcomes

Student will be able to:

- Apply the knowledge of parallel computing models to solve real time applications.
- Gain the knowledge of heterogeneous processor architectures
- Apply the multi core programming knowledge to solve the sequential tasks.

UNIT-I

Introduction to Parallel Computing: Scope of Parallel Computing, Sieve of Eratosthenes, Controland Data Approach, PRAM model of parallel computation, Design paradigms of Parallel Computing, examples, Bulk Synchronous Parallel (BSP) model, algorithms on PRAM and BSP model.

UNIT-II

Introduction to Heterogeneous Multi-Core Processors, Many cores Programming, Cell Processor Multinode Computing.

Introduction to Graphics Processors, Graphics Processing Units, GPGPUs and GPU Hardware. Programming using CUDA/ OpenCL, Direct Compute CPU alternatives, Directives and libraries, Understanding Parallelism with GPUs.

UNIT-III

Heterogeneous Multi-Core Programming with OpenCL: OpenCL Programming Model, OpenCLDevice Architectures, Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

UNIT-IV

Introduction to OpenCL: Understanding OpenCL's Concurrency and Execution Model, Dissectinga CPU/GPU, OpenCL Implementation. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU

Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), anddeveloping libraries.

UNIT-V

Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning, Dynamicparallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing

Suggested Readings:

1. David Kaeli, Perhaad Mistry, Dana Schaa and Dong Ping Zhang **,***Heterogeneous Computingwith OpenCL 2.0***,**1st Edition, Mourgan Kaufmann, 2015.
2. Vipin Kumar, George Karypis, Anshul Gupta, AnanthGrama, ―Introduction to
3. Gregory V. Wilson, *Practical Parallel Programming*, PHI, 1998.

PE 812 CS *With effect from the academic year 2019-2020*

CLOUD COMPUTING
(PROFESSIONAL ELECTIVE-V)

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- To introduce basic concepts cloud computing and enabling technologies
- To learn about Auto-Scaling, capacity planning and load balancing in cloud
- To introduce security, privacy and compliance issues in clouds
- To introduce cloud management standards and programming models

.
Course Outcomes:

Student will be able to :

- Understand the architecture and concept of different cloud models: IaaS, PaaS, SaaS
- Create virtual machine images and deploy them on cloud
- .Identify security and compliance issues in clouds.

UNIT- I

Introduction, Benefits and challenges, Cloud computing services, Resource Virtualization, Resource pooling sharing and provisioning

UNIT -II

Scaling in the Cloud, Capacity Planning , Load Balancing, File System and Storage,

UNIT-III

Multi-tenant Software, Data in Cloud , Database Technology, Content Delivery Network, Security Reference Model , Security Issues, Privacy and Compliance Issues

UNIT-IV

Portability and Interoperability Issues, Cloud Management and a Programming Model Case Study, Popular Cloud Services

UNIT- V

Enterprise architecture and SOA, Enterprise Software , Enterprise Custom Applications, Workflow and Business Processes, Enterprise Analytics and Search, Enterprise Cloud Computing Ecosystem.

Suggested Readings:

1. Cloud Computing - Sandeep Bhowmik, Cambridge University Press, 2017.

2. Enterprise Cloud Computing - Technology, Architecture, Applications by Gautam Shroff, Cambridge University Press, 2016.

3. Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra, ―*Distributed and Cloud Computing From ParallelProcessing to the Internet of Things*‖,Elsevier, 2012.

PE 813 CS *With effect from the academic year 2019-2020*

HUMAN COMPUTER INTERACTION
(PROFESSIONAL ELECTIVE-V)

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives:

- To introduce interaction frameworks and styles
- To learn about interaction design process , design standards and principles
- To introduce the concept of usability and usability testing
- To familiarize interface components and technical issues of concern

Course Outcomes:

Student will be able to :

- Describe different types of interactive environments and interaction styles
- Understand the user interface design process and the need for user-centered design
- Describe techniques for developing prototypes of user interfaces and evaluation of user interfaces
- Create an appropriate usability test plan
- Understand the human and technical issues involved in the usage of text, icons and colors in user interfaces

UNIT- I

Interaction Paradigms: Computing Environments, Analyzing Interaction Paradigms, InteractionParadigms
Interaction Frameworks and Styles: Frameworks for Understanding Interaction, Coping withComplexity, Interaction Styles.

UNIT- II

Interaction Design Process: Iterative Design, User-Centered Design, Interaction Design Models,Overview of Interaction Design Models
Discovery: Discovery Phase Framework, Collection, Interpretation , Documentation
Design: Conceptual Design, Physical Design, Evaluation, Interface Design Standards, Designing theFacets of the Interface.

UNIT- III

Design Principles: Principles of Interaction Design, Comprehensibility, Learnability, Effectiveness/Usefulness, Efficiency/Usability, Grouping, Stimulus Intensity , Proportion , Screen Complexity, Resolution/Closure, Usability Goals
Interaction Design Models: Model Human Processor, Keyboard Level Model, GOMS, Modeling Structure, Modeling Dynamics, Physical Models
Usability Testing: Usability, Usability Test, Design the Test, Prepare for the Test, Perform the Test, Process the Data

UNIT- IV
Interface Components: The WIMP Interface, Other Components
Icons: Human Issues Concerning Icons, Using Icons in Interaction Design, Technical IssuesConcerning Icons
Color: The Human Perceptual System, Using Color in Interaction Design, Color Concerns forInteraction Design, Technical Issues Concerning Color

UNIT- V

Text: Human Issues Concerning Text, Using Text in Interaction Design, Technical Issues ConcerningText
Speech and Hearing: The Human Perceptual System, Using Sound in Interaction Design, TechnicalIssues Concerning Sound
Touch and Movement: The Human Perceptual System,Using Haptics in Interaction Design, Technical Issues Concerning Haptics.

Suggested Readings:

1. Steven Heim, *The Resonant Interface: HCI Foundations for Interaction Design*, Addison-Wesley, 2007
2. J. Preece, Y. Rogers, and H. Sharp, *Interaction Design: Beyond Human-Computer Interaction*, Wiley & Sons, 2nd Edition, 2007
3. Ben Shneiderman, Catherine Plaisant, *Designingthe User Interface: Strategies for EffectiveHuman-Computer Interaction*, Addison-Wesley, 5thEdition, 2009.

PW 861 CS With effect from the academic year 2019-2020

PROJECT WORK – II

Instruction	3 Periods per week
Duration of University Examination	Viva Voce
University Examination	100 Marks
Sessionals	50 Marks
Credits	8

Course Objectives :

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic Literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes :

Student will able to :

- Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
- Evaluate different solutions based on economic and technical feasibility
- Effectively plan a project and confidently perform all aspects of project management
- Demonstrate effective written and oral communication skills

The aim of Project work –II is to implement and evaluate the proposal made as part of Project Work - I. Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments . The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

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

Re-grouping of students - deletion of inters hip candidates from groups made as part of project work-I

Re-Allotment of internship students to project guides

Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 1st week of VIIIth semester so that students get sufficient time for completion of the project.

All projects(internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for

25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction.

Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: Three periods of contact load will be assigned to each project guide.

List of NPTEL Courses Approved for the academic year 2019-2020 by BoS(CSE)

Professional Elective – III

Subject	Exam Start Date	Exam End Date	Exam Date
Introduction to Machine Learning			
Deep Learning			
Social Network			
Scalable Data Science			
Ethical Hacking			

Professional Elective – IV

Subject	Exam Start Date	Exam End Date	Exam Date
Introduction to Machine Learning			
Deep Learning			
Social Network			
Scalable Data Science			
Ethical Hacking			

Professional Elective – V

Subject	Exam Start Date	Exam End Date	Exam Date
Model Checking			
Information Theory, Coding and Cryptography			
Cloud Computing			
Scalable Data Science			
Block Chain Architecture Design and Use Cases			
Hardware Modeling using Verilog			
Software Project Managment			

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

These electives are tentative only. New NPTEL / SWAYAM courses will be indicated at the beginning of semester from time to time.

FACULTY OF ENGINEERING

Scheme of Instruction & Examination

(CBCS Curriculum for the Academic Year 2019-2020)

and

Syllabi

B.E. VII and VIII Semester

of

Four Year Degree Programme

In

Information Technology

(With effect from the academic year 2019– 2020)

(As approved in the faculty meeting held on 25-06-2019)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad – 500 007

2019

PROPOSED CBCS SCHEME OF INSTRUCTION & EXAMINATION
B.E. - VII SEMESTER
(INFORMATION TECHNOLOGY)

S.No	Course Code	CourseTitle	Scheme of Instruction				Scheme of Examination		
			L	T	P/D	Contact	CIE	SEE	Credits
Theory Courses									
1.	PC 701 IT	VLSI Design	3	1	-	4	30	70	3
2.	PC 702 IT	Big Data Analytics	3	1	-	4	30	70	3
3.	PC 703 IT	Wireless Mobile Communication	3	1	-	4	30	70	3
4.	PC 704 IT	Network Security and Cryptography	3	1	-	4	30	70	3
5.	OE - II	Open Elective -II	3	-	-	3	30	70	3
6.	OE -III	Open Elective -III	3	-	-	3	30	70	3
Practical/Laboratory Courses									
7.	PC 731 IT	VLSI Design Lab	-	-	2	2	50	25	1
8.	PC 732 IT	Big Data Analytics Lab	-	-	2	2	50	25	1
9.	PW 733 IT	Project Seminar	-	-	2	2	25	-	2
10	SI 671 IT	Summer Internship	-	-	2	2	50	-	2
		Total	**18**	**04**	**08**	**30**	**405**	**470**	**24**

OPEN ELECTIVE-II	
OE701 CE	Green Building Technologies
OE701 CS	Database Management Systems
OE702 EC	Fundamentals of IoT**
OE701 EE	Non-Conventional Energy Sources
OE701ME	Entrepreneurship

OPEN ELECTIVE-III	
OE702 CE	Road Safety Engineering
OE703 CS	Data Science Using R Programming
OE703 EC	Global and Regional Satellite Navigation Systems
OE702 EE	Illumination and Electric Traction systems**
OE702 ME	Mechatronics

*IT Electives offered only for CE/EC/EE/ME/PE branches

PC 701 IT

VLSI DESIGN

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Outcomes:

Students will be able to

- Explain VLSI Design hierarchy and analyze logic gates using CMOS & transmission gate structures.
- Identify the layers in the physical structure of ICs and draw the layouts of CMOS logic gates
- Summarize the fabrication process of CMOS ICs and analyze the DC, switching characteristics of CMOS inverter.
- Analyze dynamic CMOS & pseudo nMOS structures of logic gates, SRAM & DRAM cells
- Develop verilog code for logic gates, examine the effects of interconnect elements in logic cascades and Explain the floor-planning , routing techniques of VLSI circuits

UNIT-I

Moore's law ,VLSI Design Hierarchy, MOSFET as switches, pass characteristics, Basic logic gates and complex logic gates using CMOS, Bubble pushing, XOR and XNOR gates, AOI and OAI logic gates, Transmission gates-TG based 2-to-1 MUX, XOR, XNOR circuits.
Electrical Characteristics of MOSFETs, Threshold voltage, nFET Current-Voltage equations, trans-conductance and drain characteristics of nFET, RC model of a FET, MOS capacitances, gate-source and gate- drain capacitances, Junction capacitances in a MOSFET, scaling concept of MOSFETs

UNIT-II

Integrated Circuit definition and layers, Top and side view of IC layers, CMOS Layers-MOSFET layers in an n-well process. Silicon patterning for series and parallel connected FETs. Layouts of NOT gate, transmission gate, non-inverting buffer, NAND2, NOR2, Complex logic gate, 4 input AOI gate. Stick diagram representation of NOT, NAND2 and NOR2 .
Fabrication of CMOS ICs, CMOS process flow, Design rules: minimum space width, minimum spacing, surround, extension.

UNIT-III

Layouts of Basic Structure: nwells, active area definition, design of n^+, p^+ regions, masks for the nFET, pFET,active contact cross section and mask set, metal1 line with active contact, poly contact: cross section and layout,. Latchup and its prevention, Cell based Design
DC characteristics of the CMOS inverter , Expression for midpoint voltage of CMOS inverter, Symmetrical inverter, Inverter switching characteristics- RC switch model equivalent for the CMOS inverter, rise time and fall time expressions, fan-out, input capacitance and loading due to fan-out, propagation delay of CMOS inverter.

UNIT-IV
Pseudo nMOS logic gates, tri-state inverter circuit, Clocked CMOS circuit, charge leakage in C^2MOS circuit, Dynamic CMOS logic circuits : pre-charge and evaluation modes of operation, Domino logic, Dual rail logic networks- Differential Cascade Voltage Switch Logic (DCVSL) AND/NAND, OR/NOR gates, Complementary Pass Transistor Logic (CPL) structures.
SRAM – General SRAM cell, 4T & 6T SRAM cell design parameters, Writing to SRAM, resistor model, SRAM arrays. Dynamic RAMs: 1T DRAM cell, charge leakage and refresh in a DRAM cell

UNIT-V
VLSI Design flow, structural gate level modeling, gate primitives, gate delays, switch level modeling, behavioral and RTL operators, timing controls, blocking and non blocking assignments, conditional statements, Data flow modeling and RTL, Comparator and priority encoder , D latch and Master-Slave D flip-flop- verilog code. Arithmetic circuits: half adder, full adder, ripple carry adder, carry look ahead adder- verilog code.
Interconnect modeling; Interconnect resistance and capacitance ,sheet resistance R_s, time delay, single and multiple rung ladder circuits, simple RC inter connect model, modeling inter connect lines with a series pass FET, Crosstalk, Floor planning and routing.

Suggested Reading

1. John P. Uyemura, “Introduction to VLSI circuits and Systems”, John Wiley & Sons, 2002
2. John P. Uyemura, “Chip design for submicron VLSI: CMOS layout and simulation” IE, Cengage learning, 2006.
3. Douglas A. Pucknell, Kamran Eshraghian, “Basic VLSI Design” 3rd Edition, PHI, 2000.
4. Jan M. Rabey and others “Digital Integrated Circuits A design perspective”, Pearson Education

PC 702 IT

BIG DATA ANLAYTICS

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Objectives

Students shall be able to

- Understand big data for business intelligence.
- Identify business case studies for big data analytics.
- Defend big data Without SQL.
- Discuss the process of data analytics using Hadoop and related tools.

Course Outcomes

Student will be able to:

1. Demonstrate big data and use cases from selected business domains.
2. Apply the knowledge of NoSQL big data management and experiment with Install, configure, and run Hadoop and HDFS.
3. Analyze map-reduce analytics using Hadoop.
4. Adapt Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data Analytics.

Unit 1

Understanding Big Data: Characteristics of Data, Introduction to Big Data and its importance, Evolution of Big Data, Challenges posed by Big Data, Big data analytics and its classification, Big data applications: big data and healthcare – big data in medicine – advertising and big data, big data technologies.

Unit 2

Hadoop Distributed File System: Hadoop Ecosystem, Hadoop Architecture, Analyzing data with Hadoop, HDFS Concepts, Blocks, Namenodes and Datanodes, Hadoop FileSystems, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the FileSystem API, Writing Data, Directories, Querying the FileSystem, Deleting Data, Anatomy of File Read and Write

Unit 3

NOSQL Data Management: Introduction to NOSQL – aggregate data models , aggregates keyvalue and document data models, relationships – graph databases, schema less databases , materialized views , distribution models , sharding - version – map reduce – partitioning and combining – composing map-reduce calculations

Unit 4

MapReduce and Yarn: Hadoop MapReduce paradigm, Map and Reduce tasks, Job and Task trackers, Writing a Unit Test with MRUnit, Mapper, Reducer, MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats

Unit 5

Pig: Installing and Running Pig, an Example, Generating Examples, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators, Pig in Practice. Hive: Installing Hive, The Hive Shell, An Example, Running Hive, Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User-Defined Functions, Writing a User Defined Functions, Writing a User Defined Aggregate Function.

Suggested Reading:

1.Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilly, 2012, ISBN -13: 978-1449311520, ISBN-10: 1449311520

2. Eric Sammer, "Hadoop Operations", O'Reilly, 2012, ISBN -13 978-1449327057, ISBN-10: 1449327052 3. Vignesh Prajapati, Big data analytics with R and Hadoop, 2013, ISBN -13: 978-1782163282

4. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilly, 2012, ISBN -13: 978-1449319335

PC 703 IT

WIRELESS MOBILE COMMUNICATION

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

Course Outcomes:
Student will be able to
1. Understand the fundamental concepts of wireless and cellular Networks.
2. Understand Spread spectrum modulation techniques and compare various Medium Access Control mechanisms
3. Describe WLAN and GSM
4. Analyze different variations of TCP for mobile communication systems.
5. Discuss protocols for MANETs and WAP

Unit-I
Introduction to Wireless Communication Systems: Evolution of Mobile Radio Communications,
Examples of Wireless Communication Systems. Modern Wireless Communication Systems : Second Generation (2G) Cellular Networks, Third Generation (3G) Wireless Networks, Wireless local Loop, Wireless **Local Area Networks.The Cellular Concept**: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and Systems Capacity, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems.

Unit-II
Spread spectrum modulation techniques: Pseudo-noise sequence, direct sequence spread spectrum (DS-SS), frequency hopped spread spectrum(FHSS), performance of DS-SS, performance of FH-SS
Medium Access Control: Motivation for a specialized MAC: Hidden and Exposed terminals. Near and Far terminals; SDMA, FDMA, TDMA, and CDMA

Unit-III
Wireless LAN: IEEE 802-11 Protocol, System Architecture, Protocol Architecture, Physical Layer & MAC Layer, Newer developments, Hiper LAN
GSM: Mobile services, System architecture, Localization, Call Handling, Handover, Security, New data services.

Unit-IV
Mobile Network Layer: Mobile IP: Goals, assumptions and requirements, Entities and Terminology, IP packet delivery, Agent advertisement and discovery, Registration, Tunneling

and Encapsulation, Optimizations, Reverse tunneling, Ipv6; Dynamic host configuration protocol.

Mobile Transport Layer : Traditional TCP: Congestion control, Slow start, Fast retransmit/fast recovery, Implications on mobility; Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission/timeout freezing, Selective retransmission, Transaction oriented TCP

Unit-V

Mobile Ad hoc Networks (MANETs): Introduction, Applications & Challenges of a MANET, Routing, Classification of Routing Algorithms, Algorithms such as DSR, AODV, DSDV, etc. , Mobile Agents, Service Discovery.

PROTOCOLS AND TOOLS: Wireless Application Protocol-WAP. (Introduction, protocol architecture, and treatment of protocols of all layers), Bluetooth (User scenarios, physical layer, MAC layer, networking, security, link management) and J2ME.

Suggested Reading:

1) Theodore S. Rappaport, "Wireless Communications Principles and Practice", 2nd Edition, Pearson Education, 2003.

2) Jochen Schiller, "Mobile Communication", 2nd Edition, Pearson Education.

PC 704 IT

NETWORK SECURITY AND CRYPTOGRAPHY

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessionals	30 Marks
Credits	3

UNIT – I

Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.

UNIT – II

Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4. Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Diffie-Hellman Key Exchange.

UNIT – III

Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA-512), Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures. Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service.

UNIT – IV

Transport-level Security: Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH) Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security

UNIT – V

E-Mail Security: Pretty Good Privacy, S/MIME IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations.

Suggested reading:

1. Cryptography and Network Security – Principles and Practice: William Stallings, Pearson Education, 6th Edition
2. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition

PC 731 **VLSI DESIGN LAB**

Instruction	2 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessional	25 Marks
Credits	1

At the end of this course the students will be able to

- Demonstrate Xilinx ISE suite to write verilog code for logic gates, combinational circuits and sequential circuits .
- Write verilog code for basic logic gates, complex logic gates, combinational circuits, and sequential circuits using switch level, gate level , data flow and behavioral modeling
- Develop test bench code using verilog and verify the simulation results.
- Demonstrate the FPGA implementation of digital circuits and generate the synthesis report.
- Draw the layouts of basic logic gates using Microwind

1. Switch level modeling using Verilog
   a) Logic gates b) AOl and OAI gates
   c) Transmission gate d) Complex logic gates using CMOS

2. Gate-level Modeling—Digital circuits using gate primitives—using Verilog.
   a) Half adder and full adders b) AOl gate with and without delay c) OAl gate with and without delay c) 2:1 MUX using tri-state buffers d) S-R latch

3. . RTL Modeling of general VLSI system components.
   a) 4:1 MUX b) 2 to 4 Decoder c) 8:3 Priority encoder d) Flip-flops

4. Mixed gate-level and Switch-level modeling using Verilog
   a) Constructing a 4-input AND gate using CMOS 2-input NAND and NOR gates.
   b) Constructing a 2 to 4 decoder using CMOS 2-input AND gates and NOT gates etc.

5. Synthesis of Digital Circuits
   a) Ripple carry adder and carry look-ahead adder

6. Verilog code for finite state machine
7. Simple layouts of Inverter, NAND2 and NOR2 gates
8. Stick diagram representations of Inverter, NAND2 and NOR2 gates

PC 732 BIG DATA ANALYTICS LAB

Instruction	2 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessional	25 Marks
Credits	1

Course Objectives:

Students shall be able to

- To provide the knowledge to setup a Hadoop Cluster
- To impart knowledge to develop programs using MapReduce Technique
- To learn file handling in HDFS
- To introduce Pig, PigLatin and HiveQL to process big data
- To learn machine learning operations using Mahout Hadoop
- To introduce NoSQL databases

Course Outcomes:

Student will be able to

1. Understand Hadoop working environment
2. Work with big data applications in multi node clusters
3. Write scripts using Pig to solve real world problems
4. Write queries using Hive to analyse the datasets
5. Model and build a recommendation system using Mahout Hadoop
6. Apply big data and echo system techniques for real world

Experiments:

1. Understanding and using basic HDFS commands
2. Word count application using Mapper Reducer on single node cluster
3. Analysis of Weather Dataset on Multi node Cluster
4. Working with files in Hadoop file system: Reading, Writing and Copying
5. Writing User Defined Functions/Eval functions for filtering unwanted data in Pig
6. Retrieving user login credentials from /etc/passwd using Pig Latin
7. Working with HiveQL.
8. Writing User Defined Functions in Hive
9. Perform classification & clustering in Mahout Hadoop
10. Building a Mahout Recommendation System on a Hadoop Cluster

Suggested reading:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, April 2015.
2. Alan Gates, "Programming Pig", O'Reilly Media Inc, 2011.

PW 733 IT

PROJECT SEMINAR

Instruction	2 Periods per week
Sessional	25 Marks
Credit	2

Course Objectives:

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic Literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes:

Student will be able to :

- Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
- Evaluate different solutions based on economic and technical feasibility
- Effectively plan a project and confidently perform all aspects of project management
- Demonstrate effective written and oral communication skills

The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester.

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

Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries)

Grouping of students (max 3 in a group)

Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses , new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D

institutions. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide.

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

Each group will be required to:

1. Submit a one page synopsis before the seminar for display on notice board.
2. Give a 30 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

*Problem definition and specification

*Literature survey

*Broad knowledge of available techniques to solve a particular problem.

*Planning of the work, preparation of bar (activity) charts

*Presentation- oral and written.

SI 671 IT

SUMMER INTERNSHIP

Instruction	2 Periods per week
Sessional	25 Marks
Credit	2

Course Objectives:

- To train and provide hands-on experience in analysis, design, and programming of information systems by means of case studies and projects.
- To expose the students to industry practices and team work.
- To provide training in soft skills and also train them in presenting seminars and technical report writing.

Course Outcomes:

Student will be able to :

1. Get Practical experience of software design and development, and coding practices within Industrial/R&D Environments.
2. Gain working practices within Industrial/R&D Environments.
3. Prepare reports and other relevant documentation.

Summer Internship is introduced as part of the curricula of encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Computer Industry/Software Companies/R&D Organization for a period of 8 weeks. This will be during the summer vacation following the completion of the III year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry co-ordinate (person from industry).

After the completion of the project, student will submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the Department. Award of sessionals are to be based on the performance of the students, to be judged by a committee constituted by the department. One faculty member will co-ordinate the overall activity of Industry Attachment Program.

PROPOSED CBCS SCHEME OF INSTRUCTION & EXAMINATION
B.E. - VIII SEMESTER
(INFORMATION TECHNOLOGY)

S.No	Course Code	CourseTitle	Scheme of Instruction			Contact Hrs/Wk	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
Theory Courses									
1.	PE-III	Professional Elective-III	3	0	0	3	30	70	3
2.	PE-IV	Professional Elective-IV	3	0	0	3	30	70	3
3.	PE-V	Professional Elective-V	3	0	0	3	30	70	3
Practical/Laboratory Courses									
7	PW 833 IT	Main Project	0	0	4	4	50	100	8
		Total	**09**	**00**	**04**	**13**	**215**	**310**	**17**

PROFESSIONAL ELECTIVE-III	
Course Code	**Course Title**
PE 815 IT	Natural Language Processing
PE 816 IT	Adhoc & Sensor Networks
PE 817 IT	Computational Intelligence
PE 818 IT	Information Storage and Management

PROFESSIONAL ELECTIVE-IV	
Course Code	**Course Title**
PE 811 IT	Distributed Systems
PE 812 IT	Machine Learning
PE 813 IT	Web Services & Architecture
PE 814 IT	Data Science Using R

Professional Elective-V	
Course Code	**Course Title**
PE 819 IT	Advanced Database Management systems
PE 820 IT	Cloud Computing
PE 821 IT	Human Computer Interaction
PE 822 IT	Information Retrieval System

PE 811 IT

DISTRIBUTED SYSTEMS

(PROFESSIONAL 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 acquire an understanding of the issues in distributed systems
- To study architectures and working of distributed file systems
- To expose the students to distributed transaction management, security issues and replication

Course Outcomes:

Student will be able to :

1. Describe the problems and challenges associated with distributed systems.
2. Implement small scale distributed systems .
3. Understand design tradeoffs in large-scale distributed systems

UNIT-I

Introduction: Goals and Types of Distributed Systems

Architectures: Architectural Styles, System Architectures, Architectures versus Middleware, andSelf-Management in Distributed Systems.

Processes: Threads, Virtualization, Clients, Servers, and Code Migration.

Communication: Fundamentals, Remote Procedure Call, Message-Oriented Communication, Stream-Oriented Communication, and Multicast Communication.

UNIT-II

Naming: Names, Identifiers and Addresses, Flat Naming, Structured Naming, and Attribute-BasedNaming.

Synchronization: Clock Synchronization, Logical Clocks, Mutual Exclusion, Global Positioning ofNodes, and Election Algorithms.

Consistency and Replication: Introduction, Data-Centric Consistency Models, Client-CentricConsistency Models, Replica Management, and Consistency Protocols.

UNIT-III

Fault Tolerance: Introduction to Fault Tolerance, Process Resilience, Reliable Client-ServerCommunication, Reliable Group Communication, Distributed Commit, and Recovery.

Distributed Object-Based Systems: Architecture, Processes, Communication, Naming,Synchronization, Consistency and Replication, Fault Tolerance, and Security.

UNIT-IV

Distributed File Systems: Architecture, Processes, Communication, Naming, Synchronization,Consistency and Replication, Fault Tolerance, and Security.

Distributed Web-Based Systems: Architecture, Processes, Communication, Naming,Synchronization, Consistency and Replication, Fault Tolerance, and Security.

UNIT-V

Distributed Coordination-Based Systems: Introduction to Coordination Models, Architecture,Processes, Communication, Naming, Synchronization, Consistency and Replication, Fault Tolerance, and Security.

Map-Reduce: Example, Scaling, programming model, Apache Hadoop, Amazon Elastic Map Reduce,Mapreduce.net, Pig and Hive.

Suggested Readings:

1. Andrew S. Tanenbaum and Maarten Van Steen, ―*Distributed Systems*‖, PHI 2nd Edition, 2009.
2. R.Hill, L.Hirsch, P.Lake, S.Moshiri, ―*Guide to Cloud Computing*, Principles and Practice‖, Springer, 2013.
3. R.Buyya, J.Borberg, A.Goscinski,‖*Cloud Computing-Principles and Paradigms*‖,Wiley 2013.

PE 812 IT

MACHINE LEARNING

(PROFESSIONAL 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 introduce the basic concepts of machine learning and range of problems that can be handled by machine learning
- To introduce the concepts of instance based learning and decision tree induction
- To introduce the concepts of linear separability , Perceptron and SVM
- To learn the concepts of probabilistic inference, graphical models and evolutionary learning
- To learn the concepts of ensemble learning, dimensionality reduction and clustering

Course Outcomes:
Student will be able to :

1. Explain the strengths and weaknesses of many popular machine learing approaches
2. Recognize and implement various ways of selecting suitable model parameters for different machine learning techniques
3. Design and implement various machine learning algorithms in a range of real-world applications

UNIT-I
Introduction: Learning, Types of Machine Learning.
Concept learning: Introduction, Version Spaces and the Candidate Elimination Algorithm. **Learning**
with Trees: Constructing Decision Trees, CART, Classification Example

UNIT-II
Linear Discriminants: The Perceptron, Linear Separability, Linear Regression
Multilayer Perceptron (MLP): Going Forwards, Backwards, MLP in practices, Deriving back
Propagation SUPPORT Vector Machines: Optimal Separation, Kernels

UNIT-III

Some Basic Statistics: Averages, Variance and Covariance, The Gaussian, The Bias-VarianceTradeoff Bayesian learning: Introduction, Bayes theorem. Bayes Optimal Classifier, Naive Bayes Classifier.

Graphical Models: Bayesian networks, Approximate Inference, Making Bayesian Networks, HiddenMarkov Models, The Forward Algorithm.

UNIT-IV

Evolutionary Learning: Genetic Algorithms, Genetic Operators, Genetic Programming
Ensemble
learning: Boosting, Bagging
Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis

UNIT-V

Clustering: Introduction, Similarity and Distance Measures, Outliers, Hierarchical Methods,Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes, Comparison

Suggested Readings:

1. Tom M. Mitchell, *Machine Learning*, Mc Graw Hill, 1997
2. Stephen Marsland, *Machine Learning - An Algorithmic Perspective*, CRC Press, 2009
3. Margaret H Dunham, *Data Mining*, Pearson Edition., 2003.
4. GalitShmueli, Nitin R Patel, Peter C Bruce, *Data Mining for Business Intelligence*, Wiley India Edition, 2007
5. RajjanShinghal, *Pattern Recognition*, Oxford University Press, 2006.

PE 813 IT

WEB SERVICES AND ARCHITECTURE

(PROFESSIONAL ELECTIVE-III)

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

Course Objectives:

1. To Understand Web Services and implementation model for SOA
2. To Understand the SOA, its Principles and Benefits
3. To Understand XML concepts
4. To Understand paradigms needed for testing Web Services
5. To explore different Test Strategies for SOA-based applications
6. To implement functional testing, compliance testing and load testing of Web Services
7. To Identify bug-finding ideas in testing Web Services

UNIT – I

Evolution and Emergence of Web Services – Evolution of distributed computing. Core distributed computing technologies – client/server, CORBA, JAVA RMI, Micro Soft DCOM, MOM, Challenges in Distributed Computing, role of J2EE and XML in distributed computing, emergence of Web Services and Service Oriented Architecture (SOA). Introduction to Web Services – The definition of web services, basic operational model of web services, tools and technologies enabling web services, benefits and challenges of using web services.

UNIT – II

Web Service Architecture – Web services Architecture and its characteristics, core building blocks of web services, standards and technologies available for implementing web services, web services communication, basic steps of implementing web services. Describing Web Services – WSDL introduction, non functional service description, WSDL1.1 Vs WSDL 2.0, WSDL document, WSDL elements, WSDL binding, WSDL tools, WSDL port type, limitations of WSDL.

UNIT – III

Brief Over View of XML – XML Document structure, XML namespaces, Defining structure in XML documents, Reuse of XML schemes, Document navigation and transformation. SOAP : Simple Object Access Protocol, Inter-application communication and wire protocols, SOAP as a messaging protocol, Structure of a SOAP message, SOAP envelope, Encoding, Service Oriented Architectures, SOA revisited, Service roles in a

SOA, Reliable messaging, The enterprise Service Bus, SOA Development Lifecycle, SOAP HTTP binding, SOAP communication model, Error handling in SOAP.

UNIT – IV

Registering and Discovering Services : The role of service registries, Service discovery, Universal Description, Discovery, and Integration, UDDI Architecture, UDDI Data Model, Interfaces, UDDI Implementation, UDDI with WSDL, UDDI specification, Service Addressing and Notification, Referencing and addressing Web Services, Web Services Notification.

UNIT – V

SOA and web services security considerations, Network-level security mechanisms, Application-level security topologies, XML security standards, Semantics and Web Services, The semantic interoperability problem, The role of metadata, Service metadata, Overview of .NET and J2EE, SOA and Web Service Management, Managing Distributed System, Enterprise management Framework, Standard distributed management frameworks, Web service management, Richer schema languages, WS-Metadata Exchange.

Text Books:

Web Services & SOA Principles and Technology, Second Edition, Michael P. Papazoglou.
Developing Java Web Services, R. Nagappan, R. Skoczylas, R.P. Sriganesh, Wiley India.
Developing Enterprise Web Services, S. Chatterjee, J. Webber, Pearson Education.

Suggested Reading:

1. XML, Web Services, and the Data Revolution, F.P.Coyle, Pearson Education.
2. Building web Services with Java, 2nd Edition, S. Graham and others, Pearson Education.
3. Java Web Services, D.A. Chappell & T. Jewell, O'Reilly, SPD.
4. McGovern, et al., "Java web Services Architecture", Morgan Kaufmann Publishers, 2005.
5. J2EE Wer Services, Richard Monson-Haefel, Pearson Education.

PE 814 IT

DATA SCIENCE USING R

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

Course Outcomes:

Student will be able to :

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

Unit I

Data Science: Introduction to data science, Linear Algebra for data science, Linear equations, Distance, Hyper planes, Half spaces, Eigen values, Eigenvectors.

Unit II

Statistical Modeling, Random variables, Probability mass/density functions, sample statistics, hypothesis testing.

Unit III

Predictive Modeling: Linear Regression, Simple Linear Regression model building, Multiple Linear Regression, Logistic regression

Unit IV

Introduction to R Programming, Getting started with R: Installation of R software and using the interface, Variables and data types, R Objects, Vectors and lists, Operations: Arithmetic, Logical and Matrix operations, Data frames, functions, Control structures, Debugging and Simulation in R.

Unit V

Classification:, performance measures, Logistic regression implementation in R, K-Nearest neighbors (KNN), K-Nearest neighbors implementation in R, Clustering: K-Means Algorithm, K-Means implementation in R.

Suggested Readings:

1. R Programming for Data science, by Roger D Peng, Lean Publishing.
2. Introduction to Data Science by Rafael A Irizarry, Lean Publishing

PE 815 IT

NATURAL LANGUAGE PROCESSING

(PROFESSIONAL ELECTIVE-IV)

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

Course Objectives:

- To represent and analyze natural language both spoken and written, using statistical and finite state methods for modeling and classification. To use grammar for natural language processing.
- To study knowledge representation from its semantics view point with emphasis on applications. To study basic logical form language to encode ambiguity.
- To study augmented grammars and parsers for feature systems.
- To resolve and encode ambiguity using statistical methods to estimate lexical probabilities along with a critical study of probabilistic context free grammars and parsing.
- To interpret semantics covering ambiguity and link syntax to semantics.

Course Outcomes:

The student will be able to

1. Use statistical and finite state methods for modeling and classification for representation and analysis of natural languages, and use grammars for natural language processing.
2. Apply knowledge representation and semantics to machine translation and database semantic interpretation.
3. Perform top-down and bottom-up parsing, and parsing with features.
4. Estimate lexical probabilities, resolve ambiguity, and use probabilistic context-free grammar.
5. Able to encode ambiguity in logical form language and deal with word-sense and ambiguity and to link syntax to semantics.

UNIT- I

Natural Language Processing – Introduction to Natural Language Processing, The study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English syntax Spoken Language input and output Technologies. Written language Input – Mathematical Methods – statistical Modeling and classification Finite State Methods.

Grammar for Natural Language Processing – Parsing – Semantic and Logic Form –

UNIT- II

Introduction to semantics and knowledge representation , Some applications like Machine translation, database interface Semantic Interpretation, word senses and ambiguity, Basic logical form language, Encoding ambiguity in logical from, Thematic roles, Linking syntax and semantics, Recent trends in NLP.

UNIT- III

Grammars and Parsing: Grammars and sentence Structure, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top- Down Chart Parsing. Feature Systems and Augmented Grammars: Basic Feature system for English, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.

UNIT- IV

Semantic Interpretation, word senses and ambiguity, Basic logical form language, Encoding ambiguity in logical from, Thematic roles, Linking syntax and semantics, Recent trends in NLP.

UNIT-V

Ambiguity Resolution: Statistical Methods, Probabilistic Language Processing, Estimating Probabilities, Part-of-Speech tagging, Obtaining Lexical Probabilities, Probabilistic Context- Free Grammars, Best First Parsing. Semantics and Logical Form, Word senses and Ambiguity, Encoding Ambiguity in Logical Form.

Suggested Reading:

1. James Allen, “Natural Language Understanding”, Pearson Education
2. Christopher D Manning and Hinrich Schutze, “ Foundations of Statistical Natural Language Processing” MIT Press, 1999.
3. Akshar Bharti, Vineet Chaitanya and Rajeev Sangal, “NLP: A Paninian Perspective”,
4. Prentice Hall, New Delhi
5. D. Jurafsky, J. H. Martin, “Speech and Language Processing”, Pearson

PE 816 IT

ADHOC AND SENSOR NETWORKS

(PROFESSIONAL ELECTIVE-IV)

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

Course Objectives:
1. To provide students with an understanding of wireless ad-hoc and sensor networks
2. To enable them to recognize the wide range of applicability of these networks
3. To provide an understanding of the major design issues, including topics such as protocol mechanisms and resource constraints.

UNIT-I
Wireless Transmission Technology and Systems: Introduction, Radio Technology Primer, Available Wireless Technologies. Medium Access Control Protocols for Wireless Networks: Introduction, Background, Fundamentals of MAC Protocols.

UNIT-II
Adhoc Networks: Introduction and Definitions, Adhoc Network Applications, Design Challenges. Evaluating Adhoc Network Protocols -the Case for a Test bed. Routing in Mobile Adhoc Networks: Introduction, Flooding. Proactive Routing. On Demand Routing. Proactive Versus On Demand Debate. Location based Routing.

UNIT-III
Multicasting in Adhoc Networks: Introduction, Classifications of Protocols, Multicasting Protocols, Broadcasting. Protocol Comparisons, Overarching Issues. Transport layer Protocols in Adhoc Networks: Introduction, TCP and Adhoc Networks, Transport Layer for Adhoc Networks: Overview, Modified TCP, TCP-aware Cross-Layered Solutions. Adhoc Transport Protocol.

UNIT-IV
QoS Issue in Adhoc Networks: Introduction, Definition of QoS, Medium Access Layer, Q0S Routing, Inter- Layer Design Approaches. Security in Mobile Adhoc Networks: Vulnerabilities of Mobile Adhoc Networks, Potential Attacks, Attack Prevention Techniques. Intrusion Detection Techniques.

UNIT-V
Basic Wireless Sensor Technology: Introduction, Sensor Node Technology, Sensor Taxonomy. Introduction and Overview of Wireless Sensor Networks: Introduction, Overview MAC Protocols for Wireless Sensor networks. Applications of Wireless Sensor Networks: Examples of Category 1 and Category 2 WSN applications.

Suggested Reading:

1. Prasant Mohapatra and Srihanamurthy, "Ad Hoc Networks Technologies and Protocols", Springer, Springer International Edition, 2009.
2. Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks", A John Wiley & Sons, Inc., Publication.
3. Shivaram Murthy and B. S. Manoj, "Adhoc Networks – Principles and Protocols", Pearson Education, 2012.

PE 817 IT

COMPUTATIONAL INTELLIGENCE

(PROFESSIONAL ELECTIVE-IV)

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

Course Objective:
- ➢ To introduce the concepts of Biological and Artificial neural networks
- ➢ To understand different neural architectures with supervised learning and their learning
- ➢ mechanisms
- ➢ To study different neural architectures with unsupervised learning such as PCA Networks , Kohenen's Self-Organizing Maps
- ➢ To introduce Markov decision processes , Q-Learning and TD-Learning
- ➢ To study different models of evolution and learning, neuro-fuzzy techniques, rough set theory and their applications

Course Outcomes:
Student will be able to:
1. Design single and multi-layer feed-forward neural networks
2. Implement various unsupervised learning networks
3. Design new evolutionary operators , representations and fitness functions for specific practical problems
4. Apply fuzzy logic and rough sets to handle uncertainty and vagueness in practical problems

UNIT -I
Introduction to Computational Intelligence / Soft computing: Soft versus Hard Computing,
Various paradigms of computing, Foundations of Biological Neural Networks.
Essentials of Artificial Neural Networks: Introduction, Artificial Neuron Model, Operations of
Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity (Feed forward, feedback, Single and Multi-layer), Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules (Error Correction, Hebbian, Competitive, Stochastic), Types

of Application (Pattern Classification, Pattern Clustering, Pattern Association / Memory, Function Approximation, Prediction, Optimization)

UNIT –II

Neural Architectures with Supervised Learning: Single Layer Feed Forward Neural Networks
(Perception), Multilayer Feed forward Neural Networks (Back propagation learning), Radial Basis Function Networks, Support Vector Machines, Simulated Annealing, Boltzmann Machine, Feedback (Recurrent) Networks and Dynamical Systems.

Associative Memories: Matrix memories, Bidirectional Associative Memory, Hopfield Neural
Network

UNIT –III

Neural Architectures with Unsupervised Learning: Competitive learning, Principal Component Analysis Networks (PCA), Kohonen‘s Self-Organizing Maps, Linear Vector Quantization, Adaptive Resonance Theory (ART) Networks, Independent Component Analysis Networks (ICA).

UNIT -IV

Reinforcement Learning: Markov Decision Processes, Value Functions, Bellman Optimality
Criterion, Policy and Value Iterations, Q-Learning, TD Learning

Fuzzy Logic: Basic concepts, fuzzy set theory, basic operations, fuzzification, defuzzification,
neurofuzzy approach, applications

UNIT -V

Evolutionary and Genetic Algorithms: Basic concepts of evolutionary computing, genetic operators, fitness function and selection, genetic programming, other models of evolution and learning, ant colony systems, swarm intelligence, applications

Rough Set Theory: Basic concepts, indiscernability relation, lower and upper approximation,
decision systems based on rough approximation, applications

Suggested Readings:

1. Jacek M. Zurada. Introduction to Artificial Neural Systems, Jaico Publishers, 1992.
2. S. Haykin. Neural Networks: A Comprehensive Foundation, Prentice Hall, 1999
3. P. S. Churchland and T. J. Sejnowski. The Computational Brain. MIT Press, 1992.
4. A. M. Ibrahim. Introduction to Applied Fuzzy Electronics. PHI, 2004
5. Z. Pawlak. Rough Sets, Kluwer Academic Publishers, 1991.

PE 818 IT

INFORMATION STORAGE AND MANAGEMENT
(PROFESSIONAL ELECTIVE-IV)

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

Course Objectives:

- To introduce the concept of storage, emphasize the significance of storage technologies in IT infrastructure.
- To provides a comprehensive understanding of the various storage infrastructure components in data center environments.
- To learn about the architectures, features, and benefits of Intelligent Storage Systems.
- To understand various storage networking technologies such as FC-SAN, NAS, and IP-SAN; long-term archiving solution – CAS.
- To know about various business continuity solutions such as backup and replication.
- To understand information security role in storage networks and the emerging field of storage virtualization including storage resource management.

Course Outcomes:

Students will be able to:

1. Evaluate storage architecture; understand logical and physical components of a storage infrastructure including storage subsystems.
2. Describe storage networking technologies such as FC-SAN, NAS, IP-SAN and data archival solution – CAS.
3. Identify different storage virtualization technologies and their benefits.
4. Understand and articulate business continuity solutions including, backup and recovery technologies, and local and remote replication solutions.
5. Identify parameters of managing and monitoring storage infrastructure and describe common storage management activities and solutions

Unit - I

Introduction to Information Storage:

Information Storage, Evolution of Storage Architecture, Data Center Infrastructure, Virtualization and Cloud Computing. Data Center Environment: Application, Database Management System (DBMS), Host, Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Host Access to Data, Direct-Attached Storage, Storage Design Based on Application, Disk Native Command Queuing, Introduction to Flash Drives.

Unit-II

Data Protection: RAID, Implementation Methods, Array Components, Techniques, Levels, RAID Impact on Disk Performance, RAID Comparison, Hot Spares. Intelligent Storage Systems: Components of an Intelligent Storage System, Storage Provisioning, Types of Intelligent Storage **Systems.**

Unit -III

Fibre Channel Storage Area Networks: Overview, The SAN and Its Evolution, Components of FC SAN, FC Connectivity, Switched Fabric Ports ,Fibre Channel Architecture, Zoning, FC SAN Topologies, Virtualization in SAN. IP SAN and FCoE: iSCSI, FCIP, FCoE. Network-Attached Storage: General-Purpose Servers versus NAS Devices , Benefits of NAS, File Systems and Network File Sharing, Components of NAS ,I/O Operation , Implementations, File-Sharing Protocols, Factors Affecting NAS Performance, FileLevel Virtualization. Object-Based and Unified Storage: Object-Based Storage Devices, ContentAddressed Storage, CAS Use Cases.

UNIT-IV

Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Life Cycle, Failure Analysis, Business Impact Analysis , BC Technology Solutions. Backup and Archive: Backup Purpose, Backup Considerations ,Backup Granularity , Recovery Considerations , Backup Methods ,Backup Architecture, Backup and Restore Operations ,Backup Topologies ,Backup in NAS Environments. Local Replication: Replication Terminology, Uses of Local Replicas ,Replica Consistency, Local Replication Technologies. Remote Replication: Modes of Remote Replication ,Remote Replication Technologies, Three-Site Replication.

UNIT- V

Cloud Computing: Cloud Enabling Technologies, Characteristics of Cloud Computing, Benefits of Cloud Computing Cloud Service Models, Cloud Deployment Models, Cloud Computing Infrastructure, Cloud Challenges. Securing the Storage Infrastructure: Information Security Framework, Risk Triad, Storage Security Domains, Storage Security Domains. Managing the Storage Infrastructure: Monitoring the Storage Infrastructure, Storage Infrastructure Management Activities, Storage Infrastructure Management Challenges, Developing an Ideal Solution, Information Lifecycle Management.

Suggested Reading:

1. EMC Corporation, Information Storage and Management, Wiley India, 2nd Edition, 2011.
2. Robert Spalding, Storage Networks: The Complete Reference, Tata McGraw Hill, Osborne, 2003.
3. Marc Farley, Building Storage Networks, Tata McGraw Hill, Osborne,2nd Edition, 2001.
4. Meeta Gupta, Storage Area Network Fundamentals, Pearson Education Limited, 2002.

PE 819 IT

ADVANCED DATABASE MANAGEMENT SYSTEMS
(PROFESSIONAL ELECTIVE-V)

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

UNIT I :

Data base System Applications, data base System VS file System – View of Data – Data Abstraction –Instances and Schemas – data Models – the ER Model – Relational Model – Other Models – Database Languages – DDL – DML – database Access for applications Programs – data base Users and Administrator – Transaction Management – data base System Structure – Storage Manager – the Query Processor

UNIT II :

History of Data base Systems. Data base design and ER diagrams – Beyond ER Design Entities, Attributes and Entity sets – Relationships and Relationship sets – Additional features of ER Model – Concept Design with the ER Model – Conceptual Design for Large enterprises.

UNIT III :

Introduction to the Relational Model – Integrity Constraint Over relations – Enforcing Integrity constraints – Querying relational data – Logical data base Design – Introduction to Views – Destroying /altering Tables and Views.

Relational Algebra – Selection and projection set operations – renaming – Joins – Division – Examples of Algebra overviews – Relational calculus – Tuple relational Calculus – Domain relational calculus – Expressive Power of Algebra and calculus.

UNIT IV :

Form of Basic SQL Query – Examples of Basic SQL Queries – Introduction to Nested Queries – Correlated Nested Queries Set – Comparison Operators – Aggregative Operators – NULL values – Comparison using Null values – Logical connectivity's – AND, OR and NOT – Impact on SQL Constructs – Outer Joins – Disallowing NULL values – Complex Integrity Constraints in SQL Triggers and Active Data bases.

UNIT V :

Schema refinement – Problems Caused by redundancy – Decompositions – Problem related to decomposition – reasoning about FDS – FIRST, SECOND, THIRD Normal forms – BCNF – Lossless join Decomposition – Dependency preserving Decomposition – Schema refinement in Data base Design – Multi valued Dependencies – FORTH Normal Form.

Suggested Readings:

1. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition
2. Data base System Concepts, Silberschatz, Korth, McGraw hill, V edition.
3. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
4. Fundamentals of Database Systems, Elmasri Navrate Pearson Education
5. Introduction to Database Systems, C.J.Date Pearson Education

PE 820 IT

CLOUD COMPUTING
(PROFESSIONAL ELECTIVE-V)

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

Course Objectives:

- To introduce basic concepts cloud computing and enabling technologies
- To learn about Auto-Scaling, capacity planning and load balancing in cloud
- To introduce security, privacy and compliance issues in clouds
- To introduce cloud management standards and programming models

.
Course Outcomes:

Student will be able to :

1. Understand the architecture and concept of different cloud models: IaaS, PaaS, SaaS
2. Create virtual machine images and deploy them on cloud
3. .Identify security and compliance issues in clouds.

UNIT- I
Introduction, Benefits and challenges, Cloud computing services, Resource Virtualization, Resource pooling sharing and provisioning

UNIT -II
Scaling in the Cloud, Capacity Planning , Load Balancing, File System and Storage,

UNIT-III
Multi-tenant Software, Data in Cloud , Database Technology, Content Delivery Network, Security Reference Model , Security Issues, Privacy and Compliance Issues

UNIT-IV
Portability and Interoperability Issues, Cloud Management and a Programming Model Case Study, Popular Cloud Services

UNIT- V

Enterprise architecture and SOA, Enterprise Software , Enterprise Custom Applications, Workflow and Business Processes, Enterprise Analytics and Search, Enterprise Cloud Computing Ecosystem.

Suggested Readings:

1. Cloud Computing - Sandeep Bhowmik, Cambridge University Press, 2017.
2. Enterprise Cloud Computing - Technology, Architecture, Applications by Gautam Shroff, Cambridge University Press, 2016.
3. Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra, ―*Distributed and Cloud Computing From ParallelProcessing to the Internet of Things*‖,Elsevier, 2012.

PE 821 IT

HUMAN COMPUTER INTERACTION
(PROFESSIONAL ELECTIVE-V)

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

Course Outcomes:

- Ability to specify, design and implement a prototype that involves significant human computer interaction.
- Describe typical human–computer interaction (HCI) models and styles, as well as various historic HCI paradigms.
- Understand that the interfaces' design emerges iteratively, through repeated design–evaluation–redesign cycles involving users.
- Outline how to characterize the user experience in terms of usability, user experience goals, and design principles.
- Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems.

UNIT- I

Interaction Paradigms: Computing Environments, Analyzing Interaction Paradigms, Interaction Paradigms

Interaction Frameworks and Styles: Frameworks for Understanding Interaction, Coping with Complexity, Interaction Styles.

UNIT- II

Interaction Design **Process:** Iterative Design, User-Centered Design, Interaction Design Models, Overview of Interaction Design Models

Discovery: Discovery Phase Framework, Collection, Interpretation, Documentation

Design: Conceptual Design, Physical Design, Evaluation, Interface Design Standards, Designing the Facets of the Interface

UNIT- III

Design Principles: Principles of Interaction Design, Comprehensibility, Learn ability, Effectiveness/Usefulness, Efficiency/Usability, Grouping, Stimulus Intensity, Proportion, Screen Complexity, Resolution/Closure, and Usability Goals

Interaction Design Models: Model Human Processor , Keyboard

Level Model, GOMS, Modeling Structure, Modeling Dynamics, Physical Models

Usability Testing: Usability, Usability Test, Design the Test, Prepare for the Test, Perform the Test, Process the Data

UNIT- IV
Interface Components: The WIMP Interface, Other Components
Icons: Human Issues Concerning Icons, Using Icons in Interaction Design, Technical Issues Concerning Icons
Color: The Human Perceptual System, Using Color in Interaction Design, Color Concerns for Interaction Design, Technical Issues Concerning Color

UNIT- V
Text: Human Issues Concerning Text, Using Text in Interaction Design, Technical Issues Concerning Text **Speech and Hearing :** The Human Perceptual System, Using Sound in Interaction Design, Technical Issues Concerning Sound
Touch and Movement: The Human Perceptual System, Using Hap-tics in Interaction Design, Technical Issues Concerning Hap-tics

Suggested reading:
1. Steven Heim, *The Resonant Interface: HCI Foundations for Interaction Design*, Addison-Wesley, 2007
2. J. Preece, Y. Rogers, and H. Sharp, *Interaction Design: Beyond Human-Computer Interaction*, Wiley & Sons, 2nd Ed., 2007
3. Ben Shneiderman, Catherine Plaisant, Designing the User Interface: Strategies for Effective Human-Computer Interaction, 5th edition,, Addison-
4. Wesley, 2009

PE 822 IT

INFORMATION RETRIEVAL SYSTEMS
(PROFESSIONAL ELECTIVE-V)

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

Course Objectives

- Enable students to understand the various aspects of an Information retrieval system and its evaluation.
- To outline basic terminology and components in information retrieval systems.

Course Outcomes

1) Understanding the basics of Information retrieval and significance of IRS.
2) Understanding the various retrieval models used in IR.
3) Understanding the models of web browsing.
4) Understanding the different query languages and protocols.
5) Understanding the concepts of document clustering, text indexing.
6) Understand the process of searching in parallel and distributed IR.

UNIT-I
Introduction: Basic concepts, Past present and Future of IRS, Retrieval Process. Modeling:
Introduction, A Taxonomy of JR Models,

Retrieval: Adhoc and Filtering, A formal characterization of IR Models, Classic IR, Set Theoretic Models, Algebraic Models, Probabilistic Models, Structured Text Retrieval Models, Models for Browsing.

UNIT-II
Retrieval Evaluation: Introduction, Reference Collections. Query languages: Introduction,
Keyword-based querying, pattern Matching, Structural Queries, Query Protocols.

UNIT-III
Query operations: Introduction, User Relevance Feedback, Automatic Local Analysis, Automatic Global Analysis. Text and Multimedia Languages and Properties.
Introduction, Meta Data, Text, Markup Languages, Multimedia.

UNIT-IV

Text operations: Introduction, Document Preprocessing, Document Clustering, Text Compression, Comparing Text Compression Techniques. Indexing: Introduction, Inverted Files, Other Indices for Text Searching, Boolean Queries,

UNIT-V

Searching: Sequential Searching, Pattern Matching, Structural Queries, Compression. Parallel
and Distributed IR: Introduction, Parallel IR, Distributed JR.

Suggested Reading:

1. Ricardo. Baeza- Yates .Berthier Ribeiro- Neto, —Modern Information Retrieval ‖Pearson Education, 2008
2. .W.B.Frakes, RicardoBaeza Yates, —Information Retrieval: Data Structures & Algorithms,
   Pearson Education. 2008.

PW 833IT

PROJECT WORK – II

Instruction	3 Periods per week
Duration of University Examination	Viva Voce
University Examination	100 Marks
Sessionals	50 Marks
Credits	8

Course Objectives :

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic Literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes :

Student will able to :

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The aim of Project work –II is to implement and evaluate the proposal made as part of Project Work - I. Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments . The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

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

Re-grouping of students - deletion of inters hip candidates from groups made as part of project work-I

Re-Allotment of internship students to project guides

Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 1st week of VIIIth semester so that students get sufficient time for completion of the project.

All projects(internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for 25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction.

Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: Three periods of contact load will be assigned to each project guide.

List of NPTEL Courses Approved for the academic year 2019-2020 by BoS(CSE)

Professional Elective – IV

Subject	Exam Start Date	Exam End Date	Exam Date
Introduction to Machine Learning			
Deep Learning			
Social Network			
Scalable Data Science			
Ethical Hacking			

Professional Elective – V

Subject	Exam Start Date	Exam End Date	Exam Date
Model Checking			
Information Theory, Coding and Cryptography			
Cloud Computing			
Scalable Data Science			
Block Chain Architecture Design and Use Cases			
Hardware Modeling using Verilog			
Software Project Managment			

Open Elective – III (BME/CE/EE/EC/ME/PE)

Subject	Exam Start Date	Exam End Date	Exam Date
E-Business			
Software Engineering			
Cloud Computing			
Data Science for Engineers			

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

These electives are tentative only. New NPTEL / SWAYAM courses will be indicated at the beginning of semester from time to time.

FACULTY OF ENGINEERING

Scheme of Instruction & Examination

(CBCS Curriculum for the Academic Year 2019-2020)

and

Syllabi

B.E. VII and VIII Semester

of

Four Year Degree Programme

in

Electrical and Electronics Engineering

(With effect from the academic year 2019– 2020)

(As approved in the faculty meeting held on 25-06-2019)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad – 500 007

2019

SCHEME OF INSTRUCTION & EXAMINATION
B.E.VII– SEMESTER (CBCS)
(Electrical & Electronics Engineering)

S. No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/ Week	CIE	SEE	Duration in Hours	
Theory Course										
1.	PC701EE	Power System Operation and Control	3	1	-	4	30	70	3	3
2.	PC702EE	Electric Drives and Static Control	3	1	-	4	30	70	3	3
3.	PC703EE	Electrical Machine Design	3	1	-	4	30	70	3	3
4.	OE-II	Open Elective - II	3	-	-	3	30	70	3	3
5.	OE-III	Open Elective - III	3	-	-	3	30	70	3	3
Practical's / Laboratory Course										
6.	PC751EE	Electrical Simulation Lab	-	-	2	2	25	50	3	1
7.	PC752EE	Microprocessor and Microcontrollers Lab	-	-	2	2	25	50	3	1
8.	PW761EE	Project Work -I	-	-	2	2	50	-	-	2
9	SI	Summer Internship(Evaluation)	-	-	2	2	50	-	-	2
		Total	**15**	**03**	**8**	**13**	**300**	**450**	**-**	**21**

OPEN ELECTIVE-II	
OE701 CE	Green Building Technologies
OE701 CS	Database Management Systems
OE702 EC	Fundamentals of IoT
OE701 EE	Non-Conventional Energy Sources**
OE701ME	Entrepreneurship

OPEN ELECTIVE-III	
OE702 CE	Road Safety Engineering
OE703 CS	Data Science Using R Programming
OE703 EC	Global and Regional Satellite Navigation Systems
OE702 EE	Illumination and Electric Traction systems**
OE702 ME	Mechatronics

**OE701 & OE801EE Elective is not offered to the students of EE Department*

HS: Humanities and Sciences **BS**: Basic Science **ES**: Engineering Science**MC:** Mandatory Course **PC**: Professional Core
L: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE**: Semester End Examination (Univ. Exam)

Note:

1. Each contact hour is a Clock Hour
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment
3. ** Open Elective Subject is not offered to the students of EEE & EIE Department.

   .

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core / Elective</th></tr>
<tr><td>PC701EE</td><td colspan="6">Power System Operation and Control</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Power Systems-I
Power Systems -II</td><td>3</td><td>1</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- To understand the concepts and Importance of Load flow studies, Economic Operation of thermal power units, frequency control of inter connected Power System Networks.
- To make the students understand about reactive Power Control and Stability of Power System Networks.

Course Outcomes

At the end of the course students will be able to

1. Solve load flow by appropriate modeling of the given power system and formulation of Ybus.
2. Evaluate generation mix for economic operation with and without transmission losses.
3. Explain load frequency control and estimate the frequency deviation through modeling.
4. Analyze and describe different types of power system stability and establish SSSL.
5. Identify various methods of voltage control and study the reactive power compensation.

UNIT-I

Load Flow Studies: Formulation of Y bus for a system, modeling of tap changing and phase shifting transformer, Formulation of load flow problem, Solution of load flow by Gauss-Seidel, Newton-Raphson, Decoupled and Fast Decoupled methods, comparison of different load flow methods.

UNIT-II

Economic Operation of Power System: Input-Output curves, Heat rates and incremental cost curves, Equal Incremental cost criterion neglecting transmission losses with and without generator limits, Bmn coefficients, Economic operation including transmission losses.

UNIT-III

Load Frequency Control: Governor Characteristics, Regulation of two generators, coherency, concept of control area, Incremental power balance of a control area, Single area control, Flat frequency control, Flat tie-line frequency control, Tie-line bias control, Advantages of pool operation, Development of model for two-area control.

UNIT-IV

Power System Stability: Definitions of Steady state stability and Transient stability, Steady state stability of a synchronous machine connected to infinite bus, calculation of steady state stability limit, synchronous machine models with and without saliency, Equal area criterion, Application of equal area criterion, Swing equation, Step by step solution of Swing equation, factors effecting transient stability, Auto Reclosures, mathematical formulation of voltage stability problem.

UNIT-V

Reactive Power Control: Reactive power generation by synchronous generators, Automatic voltage regulators, FACTS Controllers-TCSC, STATCOM, UPFC.

Suggested Reading:

1. Modern Power System Analysis by D .P.Kothari and I.J.Nagrath Tata McGraw Hill
2. Power System Analysis by John.J.Grangier , William D.Stevenson Jr. Tata McGraw Hill
3. Electric Power Systems by C.L. Wadhwa New Age International (p) Ltd
4. Power System Analysis by Haadi Sadat Tata McGraw Hill.
5. 5.Electrical energy Systems Theory byElgerd Tata McGraw Hill

Course Code	Course Title						Core / Elective
PC702EE	Electric Drives and Static Control						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Power Electronics	3	1	-	-	30	70	3

Course Objectives

- To study the static control methods of DC motor, induction motor and synchronous motor.
- To study the concepts of stability, characteristics and braking methods of DC & AC motion.
- To determine the rating of motors based on heating effects and load conditions.

Course Outcomes

At the end of the course students will be able to

1. Describe the structure and operation of Electric Drive and relate to study its stability
2. Analyze characteristics and the energy loss during starting and braking of DC & AC drives
3. Use the single phase rectifier, chopper and dual converter circuits to understand the closed loop control of drives.
4. Describe the speed control methods for 3 Phase Induction Motors for stator, rotor side and the slip recovery schemes.
5. Explain the control of synchronous motor brushless DC motor, Switched reluctance motors.

Unit - I

Electric Drives: Concept and classification, four quadrant operation, Dynamics of Electric Drives, Types of Loads, Torque characteristics of Load, characteristics of Motor-Load combination, Dynamics of Motor- Load combination, Steady-state and Transient stability of Electric Drive. Characteristics of Electric Drives: Modified Speed-Torque Characteristicsof D.C Shunt motors, D.C Series motor and Induction motors.

UNIT-II

Starting of Electric Motors: Methods of Starting Electric Motors, Acceleration time, Energy relation during starting, D.C Shunt and series motor and Induction motors, Methods to reduce the energy loss duringstarting

Electric Braking: Types of Braking- Regenerative braking, dynamic braking and Plugging, Braking of D.C Shunt motor, DC Series motor and 3-phase Induction motor, Energy relation and Dynamics of Braking. Effect of load inertia and load equalization.

UNIT-III

D.C Motor Control: Single-phase controlled rectifier and chopper circuit arrangement for continuous armature current operation. Dual converter control, Circulating current and non-circulating current modes of operation,Principles of closed loop control for D.C drives.

UNIT-IV

Induction Motor Control: Speed control of 3-phase induction motor with A.C voltage regulators, Voltage source inverters and Cyclo-converters, Static rotor resistance control, slip power recovery schemes: Static Krammer drive and Scherbius drive.

UNIT-V

Synchronous Motor Control: Self controlled and Separately controlled synchronous motors, Brushless D.C motors, Switched reluctance motors

Suggested Reading:

1. S.K. Pillai, A First Course in Electrical Drives, New Age International (P) Limited, Publishers, 2000.
2. G.K. Dubey Fundamentals of Electric Drives, Narosa publication House, Delhi, 2001
3. M.D.Singh and K.B. Khanchandani, Power Electronics, Tata McGraw Hill Publishing Company Ltd., 2000.
4. Bimal. K. Bose, Modern Power Electronics and AC Drives, Pearson Education Asia, 2002.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core / Elective</th></tr>
<tr><td>PC703EE</td><td colspan="6">Electrical Machine Design</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Power Electronics</td><td>3</td><td>1</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- To Study the Qualitative & Quantitative analysis of magnetic circuit design, Electrical Circuit Design and Thermal Circuit . Design of Electrical Machine.
- To understand the Design and analysis of different types of windings used for DC/AC machines.
- To understand the Design principles of different rotating machines can be studied.

Course Outcomes

At the end of the course students will be able to

1. Make a choice of material to evolve a particular design problem at hand and make reference to the standards used by the industry
2. Understand the behavior of magnetic materials, thermal performance and rating of machines.
3. Design DC machine along with the materials, ventilation and cooling aspect used in it
4. Design AC machine along with the materials, ventilation and cooling aspect used in it.
5. To make the trials using a computer program and hundreds of design are worked in repetitive manner to evolve a cost optimized design by using computer aided design

UNIT-I

Electrical engineering materials insulating materials : Properties of ideal insulating materials, classification and types of insulating materials, Conducting materials, general properties of Cu, Al and steel, High resistance alloys, carbon and other conducting materials, super conductors-Magnetic materials: classification of magnetic materials, soft and hard magnetic materials,Sheet steel, cold rolled steels, solid core and laminated core materials.

UNIT-II

Magnetic circuit: Basic principles, magnetic circuit calculations, Flux density in air gap and tooth-Carters coefficient, Ampere turns for gap and teeth, real and apparent flux density, Magnetic leakage, armature leakage ,leakage flux from salient poles ,Field distribution curves, field turns, ampere reaction ampere turns

Thermal circuit: Types of enclosures ventilation and cooling system, Losses, temperature rise time curve, rating of electrical machines, calculation for quantity of cooling medium

Rating of motors: heating effects, load conditions and classes of duty, Determination of power rating.

UNIT-III

DC Machine design: Output equation, main dimensions, Choice of specific magnetic and electric loading, selection of no of poles, Choice of armature core length, armature diameter, Length of air gap, armature design and design of field system.

UNIT-IV

AC machine design: Transformer design, main dimensions, Output equation, core design, cooling system design, 3 Phase Induction motors: output equation, main dimensions, design of stator and rotor, Design of squirrel cage rotor, design of end rings.

Synchronous machine: Output equation, main dimensions, SCR, length of air gap,Selection of armature slots, design of field system and turbo alternators.

UNIT-V

Computer aided design: Introduction, advantages of digital computers, computer aided design- different approaches, Analysis, synthesis and hybrid method, optimization-General procedure for optimization, variable constraints, Computer aided design of 3 phase IM, Lists of symbols used, general design procedure.

Suggested Reading:

1. A.K. Sawhney, A course in Electrical Machines Design, Dhanpat Rai and Sons, 1996
2. R.K. Agarwal, Principles of Electrical Machines Design, S.K. Kataria& sons, 4^{th} Edition, 2000, NaiSarak, New Delhi.

Course Code	Course Title						Core / Elective
PC751EE	**Electrical Simulation Lab**						**Core**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
NIL	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

- The student learns analysis of electrical system through computer simulation, using software packages.
- To simulate a given electrical circuits in any environment, to analyze its dynamic characteristics and to figure out its stability considerations.

Course Outcomes

On completion of course the student will be able to :

1. Simulate the concepts of Electrical Circuits, Control Systems and Power Systems and interpret data.
2. Demonstrate the knowledge of programming environment, compiling, debugging, linking and executing variety of programs in MATLAB.
3. Demonstrate ability to develop simulink models for various electrical systems.
4. Validate simulated results from programs/simulink models with theoretical calculations.
5.

Simulation experiments should be conducted in the following areas using MATLAB / Simulink (with DSP Tool Box, Control System Tool Box & Power System Tool Box) PSpice /PSCAD / SABER / EDSA/ Power Trans

1. Verification of Network theorems
   a. Thevinin's theorem
   b. Superposition theorem
   c. Maximum power transfer theorem.
2. Transient responses of Series RLC, RL and RC circuits with Sine and Step inputs.
3. Series and Parallel resonance.
4. Bode plot, Root-Locus plot and Nyquist plot.
5. Transfer function analysis (i) Time response for Step input (ii) Frequency response for Sinusoidal input.
6. Design of Lag, Lead and Lag - Lead compensators.
7. Load flow studies.
8. Fault analysis.
9. Transient stability studies.
10. Economic Power Scheduling

11. Design of filters (Low pass filter).
12. Chopper fed dc motor drives.
13. VSI /CSI Fed induction motors drives. Doubly fed Induction motor.
14. Phase Control of DC motor Drives.
15. Control of BLDC motor.

Note: *At least ten experiments should be conducted.*

<table>
<tr><th>Course Code</th><th colspan="4">Course Title</th><th colspan="2"></th><th>Core / Elective</th></tr>
<tr><td>PC752EE</td><td colspan="6">Microprocessor and Microcontrollers Lab
(Common to EEE & EIE)</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Microprocessor & Microcontroller</td><td>-</td><td>-</td><td>-</td><td>2</td><td>25</td><td>50</td><td>1</td></tr>
</table>

Course Objectives

Course Outcomes

On completion of course the student will be able to :

1. Apply the design concepts for development of a process and interpret data.
2. Demonstrate knowledge of programming environment, compiling, debugging, linking and executing variety of programs.
3. Demonstrate documentation and presentation of the algorithms / flowcharts / programs in a record form.
4. Validate the process using known input-output parameters.
5.

List of Experiments:

For 8086:

Section 1: Using MASM/TASM

1. Programs for signed/unsigned multiplication and division.

2. Programs for finding average of N 16-bit numbers.

3. Programs for finding the largest number in an array.

4. Programs for code conversion like BCD numbers to 7-Segment.

5. Programs for compute factorial of a positive integer number

Section 2: ***Using 8086 Kit (Interfacing)***

1. 8279 – Keyboard Display: Write a small program to display a string of characters.

2. 8255-PPI: Write ALP to generate triangular wave using DAC.

3. 8253- Timer/Counter: Application of different modes.

4. 8251-USART: Write a program in ALP to establish Communication between two processors.

5. Traffic Signal Controller.

For 8051:

Section 3: ***Using 8051 Kit (Simple Programs)***

1 Data Transfer – Block move, Exchange, sorting, Finding largest element in an array.

2 Arithmetic Instructions: Multibyte operations.

3 Boolean & Logical Instructions (Bit manipulations).

4 Programs to generate delay, programs using serial port and on-Chip timer/Counter.

5. Use of JUMP and CALL instructions.

Section 4 : Program Development using 'C' cross compiler for 8051

1. Square Wave Generation using timers.

2. Interfacing of keyboard and 7-segment Display Module.

3. ADC interfacing for temperature monitoring.

4. DAC interfacing for Generation of Sinusoidal wave.

5. Stepper motor control (clockwise, anticlockwise and in precise angles)

List of Equipment:

1. 8086 Kit (with inbuilt assembler/disassembler).

2. MASM/TASM software.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core / Elective</th></tr>
<tr><td>PW761EE</td><td colspan="6">Project Work - I</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>NIL</td><td>-</td><td>-</td><td>-</td><td>2</td><td>50</td><td>0</td><td>2</td></tr>
</table>

Course Objectives:

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic Literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Outcomes:

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester.

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

Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries)

Grouping of students (max 3 in a group)

Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide.

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

Each group will be required to:

Submit a one page synopsis before the seminar for display on notice board.

Give a 30 minutes presentation followed by 10 minutes discussion.

Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

*Problem definition and specification

*Literature survey

*Broad knowledge of available techniques to solve a particular problem.

*Planning of the work, preparation of bar (activity) charts

*Presentation- oral and written.

<table>
<tr><th>Course Code</th><th colspan="4">Course Title</th><th colspan="2"></th><th>Core / Elective</th></tr>
<tr><td>SI</td><td colspan="6">Summer Internship (Evaluation)</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>NIL</td><td>-</td><td>-</td><td>-</td><td>2</td><td>50</td><td>0</td><td>2</td></tr>
</table>

Course Objectives:

- Produce an accurate record of work performed during the Internship/Co-op
- Apply engineering knowledge to a problem in industry
- Produce a technical report
- Discuss work in a team environment, if relevant to the project
- Conduct herself/himself responsibly, safely, and ethically in a professional environment

Students should carefully discuss with their industry mentor the time expectations for completion of the requirements of the class, and these expectations should be clearly articulated in the Engineering Internship/Co-op Form. Typical total time on an internship/co-op is full-time at 40 hrs/week and is typically paid.

The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship/co-op

- Overview of company/project
- Safety training
- Discussions with project teams
- Background research, review of documents, white papers, and scientific papers
- Planning, designing, and reviewing the planned work
- Executing the plans
- Documenting progress, experiments, and other technical documentation
- Further team discussions to discuss results
- Final report writing and presentation

Each student will be required to

1. Submit a one page synopsis of the seminar to be delivered 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.

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

SCHEME OF INSTRUCTION & EXAMINATION
B.E.VIII– SEMESTER (CBCS)
(Electrical & Electronics Engineering)

S. No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/ Week	CIE	SEE	Duration in Hours	
Theory Course										
1	PC801EE	Utilization of Electrical Energy	3	-	-	3	30	70	3	3
2	PE-III	Professional Elective- III	3	-	-	3	30	70	3	3
3	PE-IV	Professional Elective- IV	3	-	-	3	30	70	3	3
Practical's / Laboratory Course										
4.	PC851EE	Power Systems Lab	-	-	2	2	25	50	3	1
5.	PW861EE	Project Work- II	-	-	6	2	50	100	-	8
Total			**09**	**00**	**08**	**13**	**165**	**360**		**18**

PROFESSIONAL ELECTIVE-III	
PE801EE	Power System Reliability
PE802EE	Electric Vehicle and Hybrid Electric Vehicle
PE803EE	Machine Modeling Analysis
PE804EE	High Voltage DC Transmission

PROFESSIONAL ELECTIVE-IV	
PE805EE	Advanced Control Systems
PE806EE	Electrical Estimation Costing & Safety
PE807EE	Advanced Power Electronics
PE808EE	Power Quality

HS: Humanities and Sciences **BS**: Basic Science **ES**: Engineering Science**MC:** Mandatory Course **PC**: Professional Core
L: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE**: Semester End Examination (Univ. Exam)

Note:
1. Each contact hour is a Clock Hour
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment
3. ** Open Elective Subject is not offered to the students of EEE & EIE Department.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core / Elective</th></tr>
<tr><td>PC801EE</td><td colspan="6">Utilization of Electrical Energy</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td></td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- 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.

Course Outcomes

At the end of the course students will be able to

1. Design the resistive and inductive heating and calculate the requirements of heating power for an industrial need
2. Analyze the type of motor control required and select the type and rating of motor.
3. Design illumination for different application.
4. Understand the traction and mechanics and drive systems DC and AC
5. Analyze the use of batteries and its usage and maintenance.

UNIT-I

Industrial Heating: Advantages and methods of electric heating. Description, operation and performance of resistance ovens. Design of elements. Core type furnace, Coreless type furnace, 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 Diagram for Motor Control:

Two supply sources for 3-phase Induction motors. Direct reversing, remote control operation, Jogging operation of induction motor. Contactor control circuit. Pushbutton control stations. Over load relays, limit switches, Float switches. Interlocking methods for reversing control. Starting of Synchronous motor and motor protection.

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, Flourescent lamps, 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, system of track electrification, Traction mechanics, Speed time curves,tractive effort, Power of Traction motor, Specific energy consumption, Mechanics of train movement, Coefficient of adhesion.

UNIT-V

Traction Motors: Desirable characteristics, d.c series motors, a.c series motors, 3-phase induction motors, d.c motor series & parallel control, Shunt bridge transition, Energy saving. Batteries: Lead acid batteries, SMFbatteries, Construction and maintenance, Charging and rating of batteries.

Suggested Reading:

1. Partab G, "*Art and Science of Utilization of Electric Power*", publisher Dhanpatrai& Sons, 1990.
2. Raina K.B & Bhattacharya S.K., "*Electrical Design, Estimating and Costing*", publisher, Wiley Eastern Ltd., 1991.
3. Dubey G.K., "*Fundamentals of Electric Drives*", publisher, Narosa Public House, Delhi, 2001.
4. Openshaw Taylor, "*Utilization of Electrical Energy*".
5. Wadhwa C.L., "*Generation, Distribution & Utilization of Electrical Energy*", publisher, Wiley, 1989

<table>
<tr><th colspan="1">Course Code</th><th colspan="4">Course Title</th><th colspan="2"></th><th>Core / Elective</th></tr>
<tr><td>PE701EE</td><td colspan="6">Power System Reliability
(Professional Elective – III)</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Power System –I
Power System - II</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objective

- Understand various reliability evaluation techniques.
- Analyze generating system reliability using time and frequency methods.
- Analyze reliability for transmission and distribution systems.

Course Outcomes:

At the end of the course students will be able to

1. Understand the theory of probability.
2. Explain the terms Bath tub curve, system security, contingency and reliability of power system network.
3. Understand the importance of load point and system reliability indices of power system network.
4. Able to develop capacity outage probability tables of composite power system networks.
5. Understand the basic reliability indices

UNIT-I

Elements of Probability Theory - Probability Distributions: Random variables, density and distribution functions, Mathematical expectation- Mean and Variance, Binominal distribution, Poisson distribution, Normaldistribution, Exponential distribution, Weibull distribution.

UNIT-II

Definition of Reliability: Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Causes of failures, types of failures. Bath tub curve, MTTR, MTBF. Reliability logic diagramsfor series, parallel, series-parallel, non-series-parallel configurations. Minimal cut-set and decomposition methods

UNIT-III

Discrete Markov Chains: General modeling concepts, stochastic transitional probability matrix, time dependent probability evaluation and limiting state probability evaluation. Absorbing states. Continuous Markov Processes: Modeling concepts, State space diagrams, Stochastic Transitional Probability Matrix, Evaluating limiting state Probabilities. Reliability evaluation of repairable systems.

UNIT-IV

Generating System Reliability Analysis: Generation system model – capacity outage probability tables – Recursive relation for capacitive model building – sequential addition method – unit removal – Evaluation of lossof load and energy indices. Frequency and Duration methods – Evaluation of equivalent transitional rates of identical and non-identical units – Evaluation of cumulative probability and cumulative frequency of nonidenticalgenerating units – 2-level daily load representation – merging generation and load models

UNIT-V

Distribution System Reliability Analysis: Radial networks –Evaluation of Basic reliability indices, performance indices - load point and system reliability indices – customer oriented, loss and energy oriented indices.Parallel networks- inclusion of bus bar failures, scheduled maintenance – temporary and transient failures – weather effects – common mode failures – Evaluation of various indices.

Suggested Reading:

1. Roya Billington and Ronal N Allan, "Reliability Evaluation of Engineering Systems", Plenum Press.
2. Roy Billinton and Tonal N. Allahn, Reliability Evaluation of Power Systems, Plenum Press, New York and London (Second Edition), 1996
3. J. Endrenyi, Reliability Modeling in Electric Power Systems, John Wiley and Sons 1978 (First Edition).

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core / Elective</th></tr>
<tr><td>PE702EE</td><td colspan="6">Electric Vehicle and Hybrid Electric Vehicle(Professional Elective – III)</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>--</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- To understand the basics of electric and hybrid electric vehicles and their working
- To understand the basics of batteries and their role for electric/hybrid vehicle
- applications
- To obtain the knowledge of various types of electric/hybrid vehicles
- To understand the real time challenges in the implementation of this technology

Course Outcomes

At the end of the course students will be able to

1. Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources
2. Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
3. Analyze battery charging and discharging characteristics and estimate electric vehicle battery capacity.
4. Understand the concepts and design of hybrid electric vehicle.
5. Understand charging methods of electric, hybrid electric vehicles and sizing of ultra capacitors

Unit I

Introduction to Electric Vehicles: Sustainable Transportation - EV System - EV Advantages - Vehicle Mechanics - Performance of EVs - Electric Vehicle drivetrain - EV Transmission Configurations and components-Tractive Effort in Normal Driving - Energy Consumption - EV Market - Types of Electric Vehicle in Use Today - Electric Vehicles for the Future.

Unit II

Electric Vehicle Modelling - Consideration of Rolling Resistance - Transmission Efficiency - Consideration of Vehicle Mass - Tractive Effort - Modelling Vehicle Acceleration - Modelling Electric Vehicle Range -Aerodynamic Considerations - Ideal GearboxSteady State Model - EV Motor Sizing - General Issues in Design.

Unit III

Introduction to electric vehicle batteries - electric vehicle battery efficiency - electric vehicle battery capacity - electric vehicle battery charging - electric vehicle battery fast charging - electric vehicle battery discharging - electric vehicle battery performance – testing.

Unit IV

Hybrid Electric Vehicles - HEV Fundamentals -Architectures of HEVs- Interdisciplinary Nature of HEVs - State of the Art of HEVs - Advantages and Disadvantages - Challenges and Key Technology of HEVs - Concept of Hybridization of the Automobile-Plug-in Hybrid Electric Vehicles - Design and Control Principles of Plug-In Hybrid Electric Vehicles - Fuel Cell Hybrid Electric Drive Train Design - HEV Applications for Military Vehicles.

Unit V

Advanced topics - Battery Charger Topologies, ChargingPower Levels, and Infrastructure for Plug-InElectric and Hybrid Vehicles - The Impact of Plug-in Hybrid Electric Vehicles onDistribution Networks – Sizing Ultracapacitorsfor Hybrid Electric Vehicles.

Suggested Reading:

1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamentals, Theory and Design – MehrdadEhsani, UiminGao and Ali Emadi - Second Edition - CRC Press, 2010.
2. Electric Vehicle Technology Explained - James Larminie, John Lowry - John Wiley & Sons Ltd, - 2003. 22
3. Electric Vehicle Battery Systems - SandeepDhameja – Newnes - New Delhi – 2002.
4. Hybrid electric Vehicles Principles and applications With practical perspectives -Chris Mi, Dearborn - M. AbulMasrur, David WenzhongGao - A John Wiley & Sons, Ltd., - 2011.
5. Electric & Hybrid Vehicles – Design Fundamentals -IqbalHussain, SecondEdition, CRC Press, 2011

Course Code	Course Title						Core / Elective
PE703EE	Machine Modelling and Analysis (Professional Elective – III)						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Electrical Machines	3	-	-	-	30	70	3

Course Objectives

- Know the concepts of generalized theory of electrical machines, its voltage and current relationship.
- Transformation of machine variables between different reference frames.
- Investigate the steady state and transient behavior of the electrical machines.
- Learn the issues affecting the behavior of different types machines such as sudden application of loads, short circuit etc.,
- Linearize the machine equations for different machines.

Course Outcomes:

At the end of the course the student will be able to:

1. Represent a transfer function model for a DC machine.
2. Convert a 3-phase reference axis to a 2-phase reference axis and vice-versa.
3. Analyze the state space mode of induction machine.
4. Analyze the steady state and dynamic behavior of induction machine and synchronous machine.
5. Linearize of the induction machine and synchronous machine

UNIT I

Basic Principles for Electric Machine Analysis: Magnetically coupled circuits, Electromechanical energy conversion, Basic Two pole DC Machine – primitive 2 axis machine – Voltage and Current relationship – Torque equation.

Theory of DC Machines: Mathematical model of separately excited DC Motor, DC Series Motor, DC shunt motor and D.C. Compound Motor in state variable form – Transfer function of the motor.

UNIT II

Reference Frame Theory: Equations of transformation - Change of variables, Stationary circuit variables Transformed to the Arbitrary Reference Frame, Commonly used reference frames, Transformation between reference frames, Transformation of a balanced set, Balanced steady state phasor Relationships, Balanced steady state equations, Variables observed from various frames.

UNIT III

Theory of Symmetrical Induction Machines: Voltage and torque equations in machine variables, Equations of transformation for Rotor circuits, Voltage and torque equations in arbitrary reference frame variables, Analysis of steady state operation- state-space model of induction machine in‘d-q’ variables, Free Acceleration Characteristics, Dynamic Performance- during sudden changes in load- during a 3 phase fault at the machine terminals.

UNIT IV

Theory of Synchronous Machines: Voltage and Torque equations in machine variables, Stator Voltage equations in Arbitrary Reference Frame Variables, Voltage Equations in Rotor Reference Frame Variables: park's Equations, Torque Equations in Substitute Variables, Analysis of steady state operation, Dynamic performance - During sudden changes in Input Torque - During a 3 phase fault at the machine terminals.

UNIT V

Linearized Machine Equations: Introduction, Machine equations to be linealized-Induction machine, Synchronous machine.Linearized machine equations-Induction machines, Synchronous machines.Small-displacement stability-Eigen values, Eigen values of typical Induction machines and synchronous machines.

Suggested Reading:

1. Paul C. Krause, Oleg Wasynczuk, Scott D.Sudhoff, "*Analysis of Electric Machinery and drive systems*" John Wiley and Sons, 2nd Edition, 2006
2. C.V. Jones, *"Unified Theory of Electrical Machines"*Butterworths Publishers.
3. P.S. Bhimbra,"*Generalized Theory of Electrical Machines"*, Khanna publishers, 2002.
4. J. Meisel, "*Principles of Electromechanical Energy Conversion" McGraw Hill, 1966.*

Course Code	Course Title						Core / Elective
PE704EE	**High Voltage DC Transmission (Professional Elective – III)**						**Elective**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
Power Electronics	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To study the fundamentals of HVDC Transmission system and Converters
- To understand the control aspects of HVDC System
- The power conversion between Ac to DC and DC to AC.
- To deal with firing angle and Protection of HVDC System

Course Outcomes:

At the end of the course students will be able to

1. Understand the concept of HVDC along with applications, different kinds, planning and modern trends. Comparison with HVAC including corona losses.
2. Understand properties of converter circuits and analyse Bridge Converter circuits with and without over lap for HVDC application including inverter operation.
3. Demonstrate knowledge in the control aspects of HVDC systems
4. Understand different types of faults and protection aspects of HVDC Systems
5. Acquire Conceptual knowledge in applications of MTDC systems and their control

UNIT I

General consideration of DC and AC Transmission systems: Comparison of ACAnd DC Transmission systems, Application of DC transmission, EconomicConsideration, kinds of DC links, planning for HVDC Transmission, ModernTrends in DC Transmission, Corona loss in AC and DC system.

UNIT II

Converter Circuits: Properties of Converter circuits, Different kinds ofArrangements, Analysis of bridge converters with grid control, with and withoutOverlap angle, Equivalent circuit of rectifier.**Inversion:** Operation as an inverter, Equivalent circuit of inverter.

UNIT III

Control: Basic means of control, Limitations of manual control, Desired featuresOf control, combined characteristics of rectifier and inverter, Power reversal,Constant minimum ignition angle control, Constant Current control, ConstantExtinction angle control.

UNIT IV

Protection: Short-circuit current: Arc-back, Commutation failure, Bypass valves,DC reactors, DC circuit breakers, Protection against over voltages, Harmonic filters.

UNIT V

Multi-terminal DC systems: Application of MTDC system, Types of MTDCSystem, Comparison of series and parallel MTDC systems, Control of MTDCSystem.

Suggested Reading:

1. Kimbark E.W., Direct current Transmission Vol-1, John Wiley, 1971.
2. Padiyar K.R., HVDC Power Tranmission Systems, Wiley Eastern 1990
3. Arrilaga. J & Peter Peregrines Ltd, HVDC Transmission, Pergamon Press,1983.

<table>
<tr><th>Course Code</th><th colspan="4">Course Title</th><th colspan="2"></th><th>Core / Elective</th></tr>
<tr><td>PE801EE</td><td colspan="6">Advanced Control System
(Professional Elective – IV)</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>--</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- To learn the methods for analyzing the behavior of nonlinear control systems and the designing of control systems.

Course Outcomes

At the end of the course students will be able to

1. Recall continuous, discrete time systems and transfer functions.
2. Test the controllability and observability of a given system and Design of pole placement and observer using state feedback.
3. Identify and analyze non-linear systems using describing function analysis
4. Analyze linear and non-linear systems using Lyapunov function and design Lyapunov function for stable systems
5. Formulate an optimal control problem and design optimal control signal.

UNIT-I

Review of state-space representation: Review of continuous time systems and their solution, state models for discrete time systems described as difference Equations and transfer functions, Transfer function from State model, State- Transition matrix and solution of state equations for discrete time systems.

UNIT-II

Controllability and Observability: Concepts of Controllability and Observability, Controllability tests for continuous time, discrete-time, time- invariant systems. Observability tests for continuous time, discrete-time, time-invariant systems. And Controllability and Observability modes in State. Jordan’s canonical form, Controllable and Observable companion forms for single input single output Systems, pole placement by State feedback.

UNIT-III

Nonlinear Systems: Behavior of Nonlinear systems, jump resonance, Sub-harmonic oscillation, Limit cycles, common physical non-linearities, Singular points, phase plane-method, Construction of phase plane trajectories, Isoclines method, Delta method, Computation of time.

UNIT-IV

Stability: Lyapunov‘s stability criteria, Theorems, Direct method of Lyapunov For linear systems, Non-Linear Systems, Methods of constructing Lyapunov function Krasovki‘s, Method; Variable gradient method.

UNIT-V

Optimal Control: Formulationof optimal control problem, calculus of variations, Minimization of functionals. Formulation of variational calculus using Hamiltonian method.

Suggested Reading:

1. Gopal.M., Modern Control System Theory, Wiley Eastern Limited, 2004
2. Schulz D.G, Melsa J.L., State Functions of Linear Control Systems, McGrawHill.

Course Code	Course Title						Core / Elective
PE802EE	Electrical Estimation Costing & Safety (Professional Elective – IV)						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
--	3	-	-	-	30	70	3

Course Objectives

- Understand Electrical Wiring with IE rules. Residential Building Electrification, Electrification of commercial Installation, Electrification of factory unit Installation
- Protection against electric shocks, Safety Measures & Prevention of Accidents

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

1. Acquire the knowledge of different types of wires and wiring systems, I.E. rules and Electric supply act.
2. Explain the importance of earthling, rating of wires & cables, procedures for residential, commercial electrification.
3. Able to estimate the length of wire, cable, conduit, earth wire, and earthing and also cost of residential, commercial electrification.
4. Estimate electrification system for factory unit installation.
5. Understand and apply various safety and prevention measures against electric shocks and accidents.

UNIT- I

Electrical Wiring with IE rules: Introduction, Define types of wires; Different types of wiring system; Comparison of different types of wiring; Different types and specifications of wiring materials; Accessories and wiring tools; Prepare I.E. rules for wiring, including Electricity supply act 2003& 2005.

Elements of Estimating: Definition of ―Estimation‖. Types of estimation and estimation tools; Overhead and service charges; Purchase procedure.

UNIT-II

Residential Building Electrification : General rules guidelines for wiring of Residential Installation and positioning of equipment's; Principles of circuit design in lighting and power circuits.; Procedures for designing the circuits and deciding the number of circuits.; Method of drawing single line diagram.; Selection of type of wiring and rating of wires &cables.; Load calculations and selection of size of conductor.; Selection of rating of main switch, distributions board, protective switchgear ELCB and MCB and wiring accessories.; Earthing of Residential Installation.; Sequence to be followed for preparing Estimate; Preparation of detailed estimates and costing of Residential Installation.

UNIT-III

Electrification of commercial Installation : Concept of commercial Installation.; Differentiate between electrification of Residential and commercial Installation.; Fundamental considerations for planning of an electrical Installation system for commercial building.; Design considerations of electrical Installation system for commercial building.; Load calculations & selection of size of service connection and nature of supply.; Deciding the size of cables, bus bar and bus bar chambers.; Mounting arrangements and positioning of switch boards, distribution boards main switch etc.; Earthing of the electrical Installation; Selection of type wire, wiring system & layout.; Sequence to be followed to prepare estimate.; Preparation of detailed estimate and costing of commercial Installation.

UNIT-IV

Electrification of factory unit Installation : Concept of Industrial load.; Concept of Motor wiring circuit and single line diagram. Important guidelines about power wiring and Motor wiring.; Design consideration of Electrical Installation in small Industry/Factory/workshop.; Motor current calculations.; Selection and rating of wire, cable size & conduct.; Deciding fuse rating, starter, distribution boards main switch etc.; Deciding the cable route, determination of length of wire, cable, conduit, earth wire, and earthing.; Sequence to be followed to prepare estimate.; Preparations of detailed estimate and costing of small factory unit/ workshop.

UNIT-V

Protection against electric shocks : Electric shock- General , Protection against direct contact, Protection against indirect contact, Protection of goods in case of insulation fault, Implementation of the TT system, Implementation of the TN system, Implementation of the IT system. Protection provided for enclosed equipment: codes IP and IK, IP code definition, Elements of the IP Code and their meanings, IK Code definition, IP and IK code specifications for distribution switchboards

Safety Measures & Prevention of Accidents- Concept of electrical safety, electrical accidents, its causes & preventions.; Safety signs and symbols used in industry.; Electrical shocks and factors affecting the severity of it, method of rescuing electrocuted person & different methods of artificial respiration.; Electrical safety as per I.E. Rules 1956.; Do's & don‘ts regarding safety while working on electrical installations.; Concept of Permit system, its preparation & regulation for attending to electrical work.; Precautions to be taken to avoid fire due to electrical reasons, operation of fire extinguishers, types of fire extinguishers.

Suggested Reading:

1. Dr.S.L.Uppal of Electrical Wiring, Estimating and Costing, New Age International (p) Limited, New Delhi.
2. Electrical Design Estimating and Costing, K.B.Raina&S.K.Battacharya, new age international (p) limited. Publishers
3. Electrical estimating & costing 2nd addition By Surjitsingh
4. Electrical Installation Estimating & Costing, Gupta, J.B., S. K. Kataria& Sons, New Delhi

Course Code	Course Title						Core / Elective
PE803EE	**Advanced Power Electronics (Professional Elective – IV)**						**Elective**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
NIL	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Understanding of requirements of high power devices.
- Understanding the operation of various power converters.
- Design concepts of controllers for power electronic converters.

Course Outcomes:

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

1. Explain about High power devices
2. Obtain emulated resistance by using PWM rectifiers.
3. Perform state space modelling of DC-DC converters.
4. Explain the operation of Multi-level inverters.
5. Understand design of various controllers for power electronic systems

Unit-I

Introduction to switches:Advanced Silicon devices - Silicon HV thyristors, MCT, BRT &EST. SiC devices - diodes, thyristors, JFETs & IGBTs. Gallium nitrate devices - Diodes, MOSFETs.

Unit -II

Pulse Width Modulated Rectifiers: Properties of ideal rectifier, realization of near ideal rectifier, control of the current waveform, single phase and three-phase converter systems incorporating ideal rectifiers and design examples. Non-linear phenomena in switched mode power converters: Bifurcation and Chaos.

Unit-III

Control of DC-DC converters: State space modeling of Buck, Boost, Buck-Boost, Cuk Fly back, Forward, Push-Pull, Half & Full-bridge converters. Closed loop voltage regulations using state feedback controllers.

Soft-switching DC - DC Converters: zero-voltage-switching converters, zero-current switching converters, Multi-resonant converters and Load resonant converters.

Unit-IV

Advance converter topologies: Multi level converters - Cascaded H-Bridge, Diode clamped, NPC, Flying capacitor. Modular Multi-level converters(MMC), Multi-Input DC-DC Converters, Multi pulse PWM current source converters, Interleaved converters, Z-Source converters.

Unit-V

Control Design Techniques for Power Electronic Systems: Modeling of systems, Digital Controller Design, Optimal and Robust controller Design.

Suggested Reading:

1. Andrzej M Trzynadlowski, ‘Introduction to Modern Power Electronics, John Wiley and sons. Inc, New York, 1998
2. L. Umanand, ‘Power Electronics Essentials &Applications’, Wiley publishing Company, 1st Edition, 2014

3. B. JayantBalinga, 'Advanced High Voltage Power Device Concepts', Springer New York 2011. ISBN 978-1-4614-0268-8
4. BIN Wu, 'High Power Converters and AC Drives', IEEE press Wiley Interscience, a John wiley& sons Incpublication 2006

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core / Elective</th></tr>
<tr><td>PE804EE</td><td colspan="6">Power Quality
(Professional Elective – IV)</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>NIL</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- The student able to learn and understand the importance of power quality, different power quality issues and their effects in power system network

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

1. Describe the different PQ disturbances and state remedies to improve PQ.
2. Determine voltage sag for different network configurations.
3. Demonstrate the effect of ASD systems on power quality and the effect of voltage sags on operation of various electrical machines.
4. Evaluate harmonic levels for distribution systems.
5. Describe power quality monitoring and measuring techniques.

UNIT-I
Introduction: Introduction of the Power Quality (PQ) problem, Terms used in PQ: Voltage Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Remedies to improve power quality, power quality monitoring. Power Quality Data: Data collection, Data analysis, Database structure, Creating PQ databases, Processing PQ data.

UNIT-II
Voltage Sag – Characterization: Voltage sag – definition, causes of voltage sag, voltage sag magnitude, monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, Meshed systems, voltage sag duration. Three phase faults, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

UNIT-III
PQ Considerations in Industrial Power Systems: Adjustable speed drive (ASD) systems and applications, mitigation of harmonics. Characterization of voltage sags experienced by three-phase ASD systems: Types of sags and phase - angle jumps. Effects of momentary voltage dips on the operation of induction and synchronous motors. Voltage sag coordination for reliable plant operation.

UNIT-IV
Effects of Harmonics on Power Quality: Harmonic analysis of industrial customers, technical barriers in ASDs. Methods of evaluation of harmonic levels in industrial distribution systems. Harmonic effects on transformers. Impact of distribution system capacitor banks on PQ. Guidelines for limiting voltage harmonics.

UNIT-V

Power Quality Monitoring: Introduction, site surveys, Transducers, IECmeasurement techniques for Harmonics, Flicker, IEC Flicker meter.

Suggested Reading:

1. Math H.J. Bollen, Understanding Power Quality Problems, IEEE Press, 1999.
2. Roger C. Dugan, MarkF. McGranaghan, Surya Santoso, H.WayneBeaty, Electrical Power Systems Quality, Second Edition, Tata McGraw-Hill Edition.
3. C. Sankaran, Power Quality, CRC Press, 2002.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core / Elective</th></tr>
<tr><td>PC851EE</td><td colspan="6">Power System Lab</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Power Systems</td><td>-</td><td>-</td><td>-</td><td>2</td><td>25</td><td>50</td><td>1</td></tr>
</table>

Course Objectives:

Course Outcomes

On completion of course the student will be able to :

1. Analyze the performance of different types of transmission lines.
2. Demonstrate the characteristics of various types of relays
3. Demonstrate the various protection methods of transformer
4. Demonstrate the location of fault in underground cables.
5. Demonstrate synchronisation of alternators and load sharing.
6. Estimate string efficiency and voltage distribution of string insulators.

List of Experiments:

1. Determination of regulation & efficiency of Short, Medium and Long transmission lines.
2. IDMT characteristics of Over-current relay & Study of Bucholz relay.
3. Determination of A, B, C, D constants of Short, Medium and Long lines. Drawing of Circle diagrams.
4. Differential protection of transformer.
5. Sequence impedance of 3-Phase Alternators.
6. Determination of positive, negative and zero-sequence reactance of 3- Phase transformers using sequence current excitation fault calculation.
7. Synchronous machine reactance and time constant from 3-Phase S.Ctest.
8. Characteristics of Static relays.
9. Static excitation of Synchronous Generator.
10. Determination of dielectric strength of oils and study of Megger.
11. Parallel operation of Alternators.
12. Measurement of capacitance of 3-core cables.
13. Fault location of Underground cables.
14. Simulation of string of insulators for determination of Voltage distribution and String efficiency.

Course Code	Course Title						Core / Elective
PW861EE	Project Work- II						PW
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	6	50	100	8

Course Objectives

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic Literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas .

Outcomes:

1. demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
2. evaluate different solutions based on economic and technical feasibility
3. effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills.
5. Demonstrate team work.

The aim of project work –II is to implement and evaluate the proposal made as part of project - I. Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

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

- Re-grouping of students - deletion of internship candidates from groups made as part of project work-I
- Re-Allotment of internship students to project guides
- Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 1nd week of VIII semester so that students get sufficient time for completion of the project.

All projects(internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for 25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction.

Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: Three periods of contact load will be assigned to each project guide.

FACULTY OF ENGINEERING

Scheme of Instruction & Examination

(CBCS Curriculum for the Academic Year 2019-2020)

and

Syllabi

B.E. VII and VIII Semester

of

Four Year Degree Programme

in

Electronics and Instrumentation Engineering

(With effect from the academic year 2019– 2020)
(As approved in the faculty meeting held on 25- 6-2019)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad – 500 007

2019

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VII – Semester (CBCS)
(ELECTRONICS AND INSTRUMENTATION ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/ Week	CIE	SEE	Duration in Hours	
Theory Course										
1.	PC705EE	Opto Electronic Instrumentation	3	-	-	3	30	70	3	3
2.	PC706EE	Virtual Instrumentation	3	-	-	3	30	70	3	3
3.	PC707EE	Analytical Instrumentation	3	-	-	3	30	70	3	3
4.	OE-II	Open Elective - II	3	-	-	3	30	70	3	3
5.	OE-III	Open Elective - III	3	-	-	3	30	70	3	3
Practical's / Laboratory Course										
6.	PC753EE	Instrumentation Simulation lab	-	-	2	2	25	50	3	1
7.	PC752EE	Microprocessors & Microcontrollers lab	-	-	2	2	25	50	3	1
8.	PW761EE	Project Work -I	-	-	2	2	50	-	-	2
9	SI	Summer Internship (Evaluation)	-	-	2	2	50	-	-	-
		TOTAL	**15**	**0**	**8**	**23**	**300**	**450**		**19**

OPEN ELECTIVE-II	
OE701 CE	Green Building Technologies
OE701 CS	Database Management Systems
OE702 EC	Fundamentals of IoT
OE701 EE	Non-Conventional Energy Sources**
OE701ME	Entrepreneurship

OPEN ELECTIVE-III	
OE702 CE	Road Safety Engineering
OE703 CS	Data Science Using R Programming
OE703 EC	Global and Regional Satellite Navigation Systems
OE702 EE	Illumination and Electric Traction systems**
OE702 ME	Mechatronics

HS: Humanities and Sciences **BS**: Basic Science **ES**: Engineering Science **MC:** Mandatory Course **PC**: Professional Core
L: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE**: Semester End Examination (Univ. Exam)

Note:

1. Each contact hour is a Clock Hour
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment
3. ** Open Elective Subject is not offered to the students of EEE & EIE Department.

Course Code	Course Title						Core / Elective
PC704EE	**OPTO-ELECTRONICS INSTRUMENTATION**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PC507EE	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- 1. To expose to the students on the basics of optical sources and detectors, optical fiber and fiber optic sensors.
- 2. To impart knowledge on the characteristics of optical sources and detectors.
- 3. To introduce about the Industrial applications of fiber optic sensor and laser

Course Outcomes:

On completion of the course the students will be able to:

1. Describe the properties, construction & classification of Lasers.
2. Explain operation & applications of Laser instruments with their safety measures.
3. Analyze operation & transmission in Optical fiber with their modulation techniques.
4. Express a fiber optic instrument to measure Electrical & Non Electrical parameters.
5. Analyze various optoelectronic sensors and display devices

UNIT-I

Laser fundamentals: Mechanisms Properties of Laser Generations, Optical Feedback, And Classification of LASER: Solid, Liquid, Gas, Lasers and their Respective Enginery Level Diagrams. Construction of Dye, Nd-YAG, Argon and carbon dioxide lasers, Characteristics of stabilization Q- switching and mode locking.

UNIT-II

Laser Instruments: Laser interferometers, laser strain gauges, pulse echo technique, Beam modulation telemetry. Laser welding, Laser machining and Laser spectroscopy, Line shape function, lasing threshold, Application of lasers in Engineering and Medicine, safety with lasers.

UNIT- III

Optical fibers Fundamentals: Introduction to optical fibers, Fundamentals of Transmission theory, Fiber Fabrication and Manufacturing techniques, fiber Splicing, Connectors and Jointing Technique, Electro-Optic, Mechano - Optic And Acousto-optic Modulation techniques, Losses in Optical fibers.

UNIT-IV

Fiber Optic Instrumentation: Classification and Principle of fibers optic sensors. Optical time Domain Reflectometer. Multimode passive and active fibers sensors phase modulated sensors. Measurements of currents, Voltage, pressure, Temperature, Displacement, Acceleration, and Fluid level using optical fibers.

UNIT- V

Optoelectronic Devices and Components: Photo diodes, LDRs, PIN diodes, Solar cells, LED, S phototransistors LCD, plasma Display, Opt isolators, Photo Couplers.

Suggested Reading:

1. Wilson & J.F.B. Hawkers, Optoelectronics- An Introduction Prentice Hall of India 2nd Edtions
2. Amar K. Ganguly optical & opto Electronic Instrumentation Narosa Publishing House.
3. ShukbirKumar Sarkar, Optical Fibers And fiber Optics Instrumentation, 2nd edition.S.Chand & Company
4. R.P. KharaFibre optics & Optical Commecam

Course Code	Course Title						Core / Elective
PC705EE	VIRTUAL INSTRUMENTATION						Core
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
PC507EE	3	-	-	-	30	70	3

Course Objectives:
- To introduce to the students about the interfacing techniques of various transducers.
- To expose the students to different signal conditioning circuits.
- To impart knowledge on the hardware required to build Virtual Instrument.
- To impart knowledge to build GUI for Virtual Instruments

Course Outcomes:
On completion of this course the students will be able to:
1. Describe architect of VI
2. Program a virtual instrument
3. Interface the target transducer to the signal conditioning board.
4. Design a virtual instrument.
5. Apply the concept of virtual instrumentation to real time applications.

UNTI-I
Review of virtual Instrumentation: Historical Perspectives advantages block diagram and architecture of a virtual instrument, data –flow techniques graphical programming in data flow, comparison with conventional programming.

UNIT-II
VI programming Techniques : VIS and sub- VIS , loops and charts , array, clusters and graphs, case and sequence structures, formula nodes, local and global, variable, string and file I/O.

UNIT-III
Data Acquisition Basics: ADC, DAC, DIO, Counters & Timers, PC Hardware Structures, timing interrupts DMA, Software and hardware Installation.

UNIT IV
Common Instrument Interfaces: Current loop, RS232C/RS485, GPIB, Systems buses, Interface buses, USB, PCMCLA, VXI, SCXI, PXI etc. Networking basics for office & industrial application VISA and IVL.

UNITS –V
Application of VI with analysis Tools: Image acquisition and processing .Motion Control. Fourier transforms Power spectrum, correlation methods, and windowing& Filtering Vl applications in various fields.

Suggested Reading:

1. Gary Johnson, Lab view Graphical programming, second edition, McGraw Hill, New York, 1997.
2. Lisa K., wells & Jeffrey Travis, Lab view for everyone, Prentice Hall New Jersey 1997.
3. Sokoloff, Basic concepts of Lab view. 4, prentice Hall, New Jersey, 1998.
4. S. Gupta J.P.Gupta, PC interfacing for data Acquisition & process control llnd edition, instrument Society of America, 1994.
5. Sanjay Gupta, VI using Labview 2E, McGraw Hill 2010 .

Course Code	Course Title						Core / Elective
PC706EE	**ANALYTICAL INSTRUMENTATION**						**Core**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
PC507EE	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To make the students equipped about the analysis of materials as it is an important requirement of process control and quality control in industry.
- To expose the students to principles of various analytical methods.
- To impart the knowledge on various instruments used in the analysis of materials.

Course Outcomes:

1. On completion of this course, the students will be able to:
2. Acquire knowledge of electromagnetic radiation with matter and apply analytical techniques.
3. Describe the relevance of material sampling and analysis in process control and quality control in industry.
4. Apply the knowledge of chromatography to separate the constituents from a complex mixture.
5. Identify the physical principles behind the various widely used analytical methods in the industry.
6. Select an appropriate analyzer for an industrial requirement.

UNIT-I

Review of basic components of analytical instrumentation, Calorimeter and Spectrophotometers, Electromagnetic radiation, Beer –Lamberts Law, Absorption instruments, Calorimeters, Spectrophotometers sources of error and calibration.

UNIT-II

Infra –red Spectrophotometers infra-red Spectroscopy, Basic Components types of IR Spectrometry, sample handling techniques, FT-IR Spectroscopy,Calibration,Mass Spectrometers, Basic mass Spectrometer , types, Components , Resolution and application of Mass Spectroscopy.

UNIT-III

NMR, Principle of NMR Spectroscopy, Different types of NMR Spectrometers, Chromatography, Basic of Gas Chromatography, Methods of measurement of peak areas, Liquid chromatography, types of amino acid analyzers.

UNIT-IV

Electro- Mechanical instruments, Electro-Chemical cell, Types of electrodes, potentiometers, conductivity meters, polar – graphs, PH-meters, Principle of measurements, Electrodes, Selective lon electrode, chemically sensitive semi conductor devices, Bio- Sensors.

UNIT-V

Industrial gas Analyzers, Types, Para–magnetic Oxygen analyzer, Magnetic wind instruments, Infra-red gas analyzer, Thermal conductivity analyzer, Analyzer based on gas density, Methods based on ionization.

Environmental pollution monitoring instruments: Air pollution monitoring instruments, Co-$S0_2$ – No wet Chemical air analysis, Water pollution monitoring instruments.

Suggested Reading:

1. H.M Willard, L.L.Merit, J. A. Dean, Instrumental Methods of Analysis CBS
2. Publishers, Delhi.
3. R.S. Khandpur, Analytical instruments, Tata McGraw Hills1989.

ourse Code	Course Title						Core/Elective
PC753EE	**INSTRUMENTATION SIMULATION LAB**						**Core**
Prerequisite	**L**	**T**	**D**	**P**	**CIE**	**SEE**	**Credits**
PC606EE	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives:

- To familiarize the students with different signal conditioning circuits for temperature and pressure measuring transducer.
- To familiarize the students to the calibration practices used in industries.
- To impart knowledge in the transmitter design.

Course Outcomes:

On completion of this lab, the students will be able to:

1. Simulate Electrical systems using software tools.
2. Design and simulate compensators.
3. Simulate the control system for temperature, level and pressure measurement systems.
4. Analyze ECG waveform with VI
5. Simulate digital communication system with VI

LIST OF EXPERIMENTS:

1. Verification of Network theorems (i) Thevenins theorem (ii) Superposition theorem (iii) Maximum power transfer theorem.
2. Transient responses of series RLC, RL and IRC circuits with Sine and Step inputs.
3. Series and Parallel resonance.
4. Bode Plot, Root-Locus plot and Nyquist plot.
5. Transfer function analysis (i) Time Response for Step input (ii) Frequency response for Sinusoidal input.
6. Design of Lag, Lead and Lag-Lead Compensators.
7. Design & Simulation of pressure Monitoring System Using lab view.
8. Simulation of tank Level Control system using Lab View
9. Analysis of an ECG Waveform Using Lab View.
10. Design of Temperature Monitoring System Using Lab view.
11. Simulation of Transmission &Reception of Digital Data Using Lab View.

NOTE: *Atleast ten Experiments should be completed in the Semester.*

Suggested Reading:

1. Doebelin E.O, Measurement Systems: Application and Design, McGraw Hill, 5th Edition, 2004.
2. Patranabis D, Principles of Industrial Instrumentation, Tata McGraw Hill, 3rd Edition, 2010.
3. Roy D.Choudary and Shail Jain, Linear Integrated Circuits, New Age International, 2010.

Course Code	Course Title						Core/Elective
PC752EE	MICROPROCESSOR AND MICROCONTROLLER LABORATORY (Common to EIE and EEE)						Core
Prerequisite	L	T	D	P	CIE	SEE	Credits
PC602EE	-	-	-	2	25	50	1

Course Objectives:

- 1. To introduce the architecture of 8, 16 and 32 bit microprocessor and microcontroller.
- 2. To impart microcontroller programming skills in students.
- 3. To familiarize the students with data transfer and interrupt services..

Course Outcomes:

1. On completion of this course, the students will be able to:
2. Use the various functional blocks of microprocessor and microcontrollers.
3. Write an assembly language program.
4. Interface the peripherals with microprocessors and microcontrollers.

List of Experiments:

For 8086

Section 1: Using MASM/TASM

1. Programs for signed/unsigned multiplication and division.
2. Programs for finding average of N16-bit number.
3. Programs for finding the largest number in an array.
4. Programs for code conversion like BCD number to 7-segments.
5. Programs for compute factorial of a positive integer number.

Section 2: Using 8086 Kit (Interfacing)

1. 8279 – Keyboard Display: Write a small Program to display a String of characters.
2. 8255-PPI: Write ALP to generate triangular wave using DAC.
3. 8253- Timer/ Counter: Application of different modes.
4. 8251- USART: Write a program in ALP to establish Communication between two processors.
5. Traffic Signal Controller.

For8051:

Section 3: using 8051 Kit (Simple Program)

1. Data Transfer_- Block Move, Exchange, Sorting, Finding Largest element in an array.
2. Arithmetic Instructions: Multibyte operations.
3. Boolean & Logical Instructions (Bit Manipulations).
4. Programs to generate delay, programs using serial port and on chip timer/Counter.
5. Use of JUMP and CALL instructions.

Section 4: Program Development using C Cross Compiler for 8051

1. Square wave Generation using timers**.**
2. Interfacing of keyboard and 7- segment Display Module.
3. ADC interfacing for temperature monitoring.
4. DAC interfacing for Generation of Sinusoidal wave.
5. Stepper motor control (Clockwise, anticlockwise and in precise angle)

List of Equipment:

1.8086 KIT (with inbuilt assembler/disassemble).
2. MASM/TASM Software.

Note: Atleast ten experiments should be conducted in the Semester.

Suggested Reading:

1. Douglas V. Hall, Microprocessors and Interfacing-Programming and Hardware,
2. Mc Graw Hill, 2nd Edition, 1999.
3. Kenneth J.Ayala, the 8051 Micro controller, Thomson Delmar Learning, 3 rd Edition, 2004.
4. John H Davies, MSP430 Microcontroller Basics, Newnes, 1st Edition, 2010.
5. Jonathan W Valvano Embedded Microcomputer Systems: Real Time Interfacing, CENGAGE Learning Custom Publishing, 3rd Edition, 2010.

Course Code	Course Title						Core / Elective
PW761EE	**Project Work - I**						**Core**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
NIL	**-**	**-**	**-**	**2**	**50**	**0**	**2**

Course Objectives:

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic Literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes:

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester.

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

Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries)

Grouping of students (max 3 in a group)

Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide.

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

Each group will be required to:

Submit a one page synopsis before the seminar for display on notice board.

Give a 30 minutes presentation followed by 10 minutes discussion.

Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

*Problem definition and specification

*Literature survey

*Broad knowledge of available techniques to solve a particular problem.

*Planning of the work, preparation of bar (activity) charts

*Presentation- oral and written.

Course Code	Course Title						Core/Elective
	SUMMER INTERNSHIP (Common to EIE and EEE)						Core
Prerequisite	L	T	D	P	CIE	SEE	Credits
	-	-	-	2	25	50	1

Course Objectives:

- Produce an accurate record of work performed during the Internship/Co-op
- Apply engineering knowledge to a problem in industry
- Produce a technical report
- Discuss work in a team environment, if relevant to the project
- Conduct herself/himself responsibly, safely, and ethically in a professional environment

Students should carefully discuss with their industry mentor the time expectations for completion of the requirements of the class, and these expectations should be clearly articulated in the Engineering Internship/Co-op Form. Typical total time on an internship/co-op is full-time at 40 hrs/week and is typically paid.

The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship/co-op

- Overview of company/project
- Safety training
- Discussions with project teams
- Background research, review of documents, white papers, and scientific papers
- Planning, designing, and reviewing the planned work
- Executing the plans
- Documenting progress, experiments, and other technical documentation
- Further team discussions to discuss results
- Final report writing and presentation

Each student will be required to

1. Submit a one page synopsis of the seminar to be delivered 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.

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

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VIII – Semester (CBCS)
(ELECTRONICS AND INSTRUMENTATION ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/ Week	CIE	SEE	Duration in Hours	
Theory Course										
1	PC802EE	Advance Programmable Logic Controller	3	-	-	3	30	70	3	3
2	PE-III	Professional Elective- III	3	-	-	3	30	70	3	3
3	PE-IV	Professional Elective- IV	3	-	-	3	30	70	3	3
Practical's / Laboratory Course										
4.	PW861EE	Project Work-II	-	-	6	6	50	100	-	8
5.	PC852EE	Process Instrumentation Lab	-	-	2	2	25	50	3	1
TOTAL			**09**	**-**	**08**	**17**	**165**	**360**	**-**	**18**

PROFESSIONAL ELECTIVE-III	
PE706EE	Digital Control Systems
PE707EE	Automation in Process Control
PE708EE	Hydraulic & Pneumatics
PE709EE	Software Design tools for Sensing & Control

PROFESSIONAL ELECTIVE-IV	
PE805EE	Advance Digital Signal Processing
PE806EE	Biomedical Signal Processing
PE807EE	Power plant design and safety management
PE804EE	Power Quality

HS: Humanities and Sciences **BS**: Basic Science **ES**: Engineering Science **MC:** Mandatory Course **PC**: Professional Core
L: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE**: Semester End Examination (Univ. Exam)

Note:
1. Each contact hour is a Clock Hour
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment
3. ** Open Elective Subject is not offered to the students of EEE & EIE Department.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PC802EE</td><td colspan="6">ADVANCE PROGRAMMABLE LOGIC CONTROLLER</td><td rowspan="2">Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td><td>Credits</td></tr>
<tr><td>PC605EE</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- To acquire good knowledge of industrial automation.
- To acquire good knowledge of PLC programming.
- To know the basics of networking of PLC.

Course Outcomes

At the end of the course students will be able to

1. Describe the architecture of PLC and differentiate between legal & illegal PLC ladder programming layouts.
2. Create Ladder diagram from a sequence of operational steps using Timers and counters with the '9' planning steps.
3. List and define the six basic intermediate functions.
4. Describe and apply the PLC MOVE/JUMP function to industrial problems in combination with other PLCs Data Handling functions.
5. Covert input signal to a form usable by input modules and output module to a form usable for output devices.

UNIT-I

PLC Basics: Definition and History of PLC- PLC advantages and disadvantages – Over all PLC Systems – CPUs and Programmer/Monitors –PLC input and output models– Printing PLC Information Programming Procedures –Programming Equipment – Programming Formats – Proper Construction of PLC Diagrams – Devices to which PLC input and output modules are connected – Input on/off Switching devices – Input analog devices – Output analog on/off devices and output analog devices.

UNIT-II

Basic PLC Programming and Basic PLC Functions: Programming on/off inputs to produce on/off outputs- PLC input instructions – Out puts – Operational procedures– Contact and coil input/output programming examples- Relation of digital gate logic contact/coil logic – PLC programming and conversion examples – creating ladder diagrams from process control descriptions – Sequence listings – Large process ladder diagram constructions.

General Characteristics of Registers – Module addressing – Holding registers – Input registers – PLC timer functions – examples of timer functions. Industrial applications – PLC counter functions.

UNIT-III

Intermediate Functions: PLC Arithmetic functions – PLC additions and subtractions– The PLC repetitive clock – PLC Multiplications, Division and Square Root – PLC trigonometric and Log functions- Other PLC Arithmetic Functions – PLC number comparison functions – PLC basic comparison functions and applications – Numbering systems and number conversion functions – PLC conversion between decimal BCD – Hexadecimals numbering systems.

UNIT-IV

Data Handling Functions: The PLC skip and master control relay functions – Jump functions – Jump with non return – Jump with return PLC data move Systems – The PLC functions and applications – PLC functions working with bits – PLC digital bit functions and applications – PLC Sequence functions – PLC matrix functions.

UNIT-V

Advanced PLC Functions:

Analog PLC Operation: Types of PLC analog modules & Systems – PLC Analog Signal Processing - PID Control of Continuous Processes - Networking PLCs

Suggested Reading:

1. John W. Weff, Ronald A Reis, *Programmable Logic Controllers,* Prentice Hall of India Private Limited, Fifth edition, 2003.

Course Code	Course Title						Core / Elective
PE706EE	**DIGITAL CONTROL SYSTEMS (Professional Elective-III)**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
PC504EE	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To impart knowledge in the significance and features of design of discrete- time control system.
- To review on the different transform techniques for digital control system design.
- To impart knowledge on the techniques to analyze the system performance in the discrete-time domain.
- To impart knowledge in discrete state space controller design.

Course Outcomes:

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

1. Understand the various issues related to digital control systems such as effects of sampling and quantization, discrete time signals and models.
2. Represent a discrete-time control system using state space technique.
3. Design discrete control systems via pole placement.
4. Design observers for discrete control systems.
5. Analyze the stability of a discrete-time control system.

UNIT-I

Introduction to digital control Configuration of basic digital control system: discrete transfer function, discrete model sampled data systems using z- transform, transfer function model, signal analysis and dynamic response, zero-order hold equivalent, introduction to first-order-hold equivalent, transformation between splane, z-plane and w-plane, z-Domain description of sampled continuous-time systems. Controller design Controller Design using transform techniques: Root locus and frequency domain analysis compensator design.

UNIT-2

State space theory Control system analysis using state variable method: vector and matrices, state variable representation, conversion of state variable to transfer function and vice versa, conversion of transfer function to canonical state variable models, system realization, solution of state equations. Solution of discrete-time state equation. Computational methods.

UNIT-III

State space design using state-space methods: controllability and observability, control law design, pole placement, pole placement design using computer aided control system design (CACSD).

UNIT-IV

Observer design: Full order and reduced order discrete observer design - Kalman filter and extended Kalman filter design.

UNIT-V

Stability improvement by state feedback: Stability analysis and Jury's stability criterion, Lyapunov stability analysis to linear systems and discrete systems, Stability Improvement by state feedback.

Suggested Reading:

1. K. Ogata, Discrete Time Control Systems, Prentice Hall India, 2nd edition, 2005.
2. M. Gopal, Digital Control and state variable methods, Tata McGraw Hill, 3rd edition., 2008.
3. R. Isermann, Digital Control Systems Vol 1&2, Springer-Verlag, 1991.
4. B. C. Kuo, Digital Control System, Oxford University Press, 2nd edition., 2007

Course Code	Course Title						Core / Elective
PE707EE	AUTOMATION IN PROCESS CONTROL (Professional Elective-III)						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PC606EE	3	-	-	-	30	70	3

Course Objectives:
- To impart knowledge on automobile system, its subsystems and components.
- To expose the students to the concepts of various sensors used in automobile systems.
- To impart knowledge about the electronics and software

Course Outcomes:
On the completion of this course the students will be able to:
1. Identify the automotive system and its components.
2. Apply the knowledge of various sensors and conditioning circuit in automotive systems.
3. Explain the various control strategies; the electronics and software used in automotive application.
4. Apply the knowledge of automation for describing real time systems.
5. Describe the communication protocols used in industrial automation.

UNIT-I
Data Acquisition and Control: Interfacing input signals, Digital signal conditioning, Output system with continuous actuators, Data acquisition and control using standard Add-on cards, pug-in cards, Input/ Output devices.

UNIT-II
SCADA: introduction to Supervisory Control and Data Acquisition (SCADA), Configuration of SCADA system, Remote Terminal Units, Typical Application as applied to process control systems
.
UNIT-III
DCS: Computers –Hierarchical control, DCS basics, Analog control, Direct Digital control, DCS Hardware Configuration, Software configuration, Displays: Groups displays, Overview display, Detail displays and Graphics displays. Local Control Units (LCU).DCS advantages over Mainframe Direct Digital Control. DCS P &ID symbols DCS integration with PLCS.

UNIT-IV
Examples of Experimental Computer Control of Processes:
Computer Control of Liquid level system, Computer control of a heat exchanger, temperature control for plastic injection moulding processes, on line optimizing control of a Distillation column.

UNIT-V

Smart sensors and Field Bus: Smart sensors, Smart differential pressure transmitter, Smart temperature transmitter, Smart positioners for control valves, Advantages of smart sensors, Filed bus systems, HART protocol, Device description language, topology of field bus, industrial Field buses.

Suggested Reading:

1. Krishna Kant, Computer Based industrial Control, Prentice Hall of India, 2001.
2. M.Chidambaram, Computer Control of processes, Narosa Publishing Housem, New Delhi 2003
3. Bela.G.Liptak, Instrument Engineers Handbook 3rd edition Gulf Publications, 1995.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PE708EE</td><td colspan="6">HYDRAULICS AND PNEUMATICS
(Professional Elective-III)</td><td rowspan="2">Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td><td>Credits</td></tr>
<tr><td>PC606EE</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives:

- To provide an understanding of the working of hydraulic and pneumatic systems.
- To provide an understanding of energy transfer in hydraulic actuators and motors
- To provide knowledge about controlling components of hydraulic and pneumatic systems
- To provide knowledge of design of hydraulic and pneumatic systems and analyze them.

Course Outcomes:

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

1. Acquire knowledge about working of hydraulic and pneumatic systems.
2. Identify the controlling components of hydraulic and pneumatic systems.
3. Select and prepare a distribution system for compressed air.
4. Compile the design of hydraulic and pneumatic systems and analyze them.
5. Demonstrate the need of pressure and time dependent controls.

Unit-I

Introduction to Hydraulic Power: Pascal's law and problems on Pascal's Law, continuity equations, Introduction to conversion of units, Structure of Hydraulic Control System. The Source of Hydraulic Power: Pumps Pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, pump selection. Variable displacement pumps. Hydraulic Actuators: Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading.

Unit-II

Hydraulic Motors: Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, Hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance. Control Components in Hydraulic Systems: Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves.

Unit-III

Hydraulic Circuit Design and Analysis: Control of single and double – acting hydraulic cylinder, regenerative circuit, pump unloading circuit, counter balance valve application, hydraulic cylinder sequencing circuits. Cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, Accumulators. Maintenance of
Hydraulic Systems: Hydraulic oils; desirable properties, general type of fluids, sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting.

Unit-IV

Introduction to Pneumatic Control: Choice of working medium, characteristics of compressed air. Structure of pneumatic control system. Compressed air: Production of compressed air – compressors, preparation of compressed air- Driers, filters, regulators, lubricators, distribution of compressed air. Pneumatic Actuators: Linear cylinders – types, conventional type of cylinder working, end position cushioning, seals, mounting arrangements applications.

Unit-V

Directional Control Valves: Symbolic representation as per ISO 1219 and ISO 5599. Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve. Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, use of memory valve. Flow control valves and speed control of cylinders supply air throttling and exhaust air throttling, use of quick exhaust valve. Signal **Processing Elements:** Use of Logic gates – OR and AND gates pneumatic applications, practical examples involving the use of Logic gates, Pressure dependent controls types construction– practical applications, time dependent controls – principle, construction, practical applications.

Suggested Reading:

1. 1.Anthony Esposito, Fluid Power with applications, Pearson education, Inc., 5 Th Edition, 2000.
2. 2.Andrew Parr, Pneumatics and Hydraulics, Jaico Publishing Co. 2000.
3. 3.Dr.Niranjan Murthy and Dr.R.K.Hegde, Hydraulics and Pneumatics, Sapna Publications, 2013.
4. 4.Majumdar S.R., Oil Hydraulics Systems - Principles and Maintenance, Tata McGraw-Hill, 2001.
5. 5.Majumdar, S.R., Pneumatic Systems – Principles and Maintenance, Tata McGraw Hill, 2007.
6. Srinivasan. R, Hydraulic and Pneumatic Control, Tata McGraw - Hill Education, 2nd Edition, 2012.
7. Shanmugasundaram.K, Hydraulic and Pneumatic controls, Chand & Co, 2006.

Course Code	Course Title						Core / Elective
PE709EE	**SOFTWARE DESIGN TOOLS FOR SENSING AND CONTROL (Professional Elective-III)**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To expose the students to the software tools available for sensor and control system design.
- To demonstrate the analytical and numerical modeling of various sensors in macro, meso and micro scale and to study its characteristics through simulation.
- To expose the students to modeling of physical systems, design and evaluation of various control methods.
- To expose the students to real time control implementation platforms and to practice on implementation of simple controllers.

Course Outcomes:

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

1. Select an appropriate software tools for sensor and actuator design.
2. Design model and simulate various sensing and actuating mechanisms.
3. Design controller and evaluate its performance through simulation
4. Design a controller using state space method and evaluate its performance through simulation.

Unit-I

Course Content: Software tools for sensor design: Introduction to history of sensor design software tools, importance and need of software tools. Recent developments in sensor design and analysis software tools. Introduction to COMSOL Multiphysics, Structural Mechanics: Analysis of mechanical structures to static or dynamic loads. Stationary, transient, eigenmode/modal, parametric, quasi-static and frequency-response analysis.

Unit-II

Electrical: AC/DC Module for simulating electric, magnetic, and electromagnetic fields in static and low-frequency applications. Design and simulation of sensors and actuators using COMSOL. Software tools for micro sensor design: Introduction to IntelliSuite, mechanism design, development of sensors and actuators.

Unit-III

Introduction to Coventorware: Description of main modules, Architect, Designer, Analyzer and Integrator. System-level and physical-level design approaches. Introduction to meshing and result visualization. Design and simulation of sensors using Coventorware.

Unit-IV

Software tools for control design: Introduction to MATLAB, Simulink and Scilab. Introduction to toolboxes. Control design problems using classical control. Control design problems using state space approach.

Unit-V

Implementation of controllers in real time: Introduction to various hardware platforms, Control design and implementation for electrical/mechanical/electromechanical/chemical Processes using dSPACE, Lab VIEW and OPAL-RT.

Suggested Reading:

1. Roger W. Pryor, Multiphysics Modeling Using COMSOL:A First Principles Approach, Jones and Bartlett Publishers, 1st Edition, 2011.
2. Tamara Bechtold, Gabriela Schrag and Lihong Feng, System-level Modeling of MEMS, Wiley-VCH Verlag GmbH & Co, 1st Edition, 2013.
3. Holly Moore, MATLAB for Engineers, Pearson Education, 5th Edition, 2017.
4. Brian Hahn and Daniel Valentine, Essential MATLAB for Engineers and Scientists,
5. Elsevier, Acadamic press, 6th edition.

Reference Books:

1. Mehrzad Tabatabaian, COMSOL 5 for Engineers, Mercury Learning & Information,
2. 1st Edition, 2015.
3. S R Otto and J P Denier, An Introduction to Programming and Numerical Methods in
4. MATLAB, Springer-verlag, 1st Edition, 2005.
5. Stephen J Chapman, MATLAB Programming for Engineers, Bookware Companion
6. Series, 5 th Edition, 2015.
7. Amos Gilat, MATLAB – An Introduction with Applications, John Wiley & Sons,
8. Inc., 5th Edition, 2014.

Course Code	Course Title						Core / Elective
PE805EE	**ADVANCED DIGITAL SIGNAL PROCESSING**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PC505EE	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To acquire good knowledge of advanced Digital Signal Processing.
- To acquire good knowledge of wavelet and other related transforms.
- To know the basics of DSP processors.

Course Outcomes

At the end of the course students will be able to

1. Describe Multi-rate Digital Signal Processing.
2. Explain the techniques for measurement and control of four basic parameters like level temperature, pressure and flow for power station as well as general process control systems.
3. Describe the Wavelet and other related Transform.
4. Explain and design Multi-rate Filter Banks.
5. Explain the DSP Processors.

UNIT-I

Multi-rate Digital Signal Processing: Fundamentals of Multi-rate systems, Basic multi-rate operations, Decimation, interpolation, filter design and implementation of sampling rate conversion, polyphase filter structures, time variant filter, structures, multistage implementation of sampling rate conversion of BP signals, sampling rate conversion by an arbitrary factor, interconnection of building blocks, polyphase representation, multistage implementations.

UNIT-II

Wavelet Transform: Introduction to wavelets, wavelets and wavelet expansion systems, discrete wavelet transform multi resolution formulation of wavelet systems, Haar Wavelet and other wavelet representations, scaling function, wavelet functions, Parseval's theorem.

UNIT-III

Multi-rate Filter Banks: Maximally decimated filter banks, errors created in QMF banks, simple alias free QMF system, power symmetric filter banks, M channel filter banks, polyphase representation, PR systems, alias free filter banks, Linear phase PR QMF banks, cosine modulated filter banks, Wavelet transform and its relation to multi-rate filter banks, paraunitary PR filter banks.

UNIT-IV

Introduction to DSP Processors: Differences between DSP and other p architectures, their comparison and need for special ASPs, RISC & CISC CPUs.

UNIT-V

Overview of DSP Processor Design: Fixed point DSPs – Architecture of TMS 320C 5X, C54X Processors, addressing modes, Assembly instructions, Pipelining and on-chip peripherals. Floating point DSPs: Architecture of TMS 320 – IX.

Suggested Reading:

1. P. P. Vaidyanathan, "Multirate filters and Filter banks", PH International, Englewood Cliffs
2. Rabiner and Schafer, "Multirate Signal Processing", PH International, Englewood Cliffs.
3. C. S. Burrus, Ramesh and A. Gopinath, "Introduction to Wavelets and Wavelet Transform", Prentice Hall Inc.
4. C. Marren & G. Ewess, “A Simple Approach to Digital Signal Processing”, WILEY Inter-science, 1996.
5. K. Shin, “DSP Applications with TMS 32 Family”, Prentice Hall, 1987.

Course Code	Course Title						Core / Elective
PE806EE	BIOMEDICAL SIGNAL PROCESSING						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PC505EE	3	-	-	-	30	70	3

Course Objectives

- To acquire good knowledge of biomedical signal and its signal processing.
- To acquire good knowledge of filter design for biomedical signal.

Course Outcomes

At the end of the course students will be able to

1. Describe biomedical signal origin & dynamics.
2. Identify artifact in biomedical signal.
3. Design various time domain filtering for the removal of artifact from biomedical signal.
4. Design frequency domain filtering for the removal of artifact from biomedical signal.
5. Explain design methods for event detection.

Unit-I

Fundamentals of BMI: Preliminaries; Biomedical signal origin & dynamics -ECG
Biomedical signal origin and its dynamics-EEG, EMG etc.

Unit-II

Filtering for Removal of artifacts -I: Statistical Preliminaries; Time domain filtering (Synchronized Averaging, Moving Average)

Unit-III

Filtering for Removal of artifacts -II: Time domain filtering (Moving Average Filter to Integration, Derivative-based operator), Frequency Domain Filtering (Notch Filter).

Unit-IV

Filtering for Removal of artifacts -III: Optimal Filtering: The Weiner Filter and
Adaptive Filter- Selecting Appropriate Filters.

Unit-V

Event Detection: Example events (viz. P, QRS and T wave in ECG) Derivative based Approaches for QRS Detection Pan Tompkins Algorithm for QRS Detection.

Suggested Reading:

1. R M Rangayyan "Biomedical Signal Analysis: A case Based Approach", IEEE Press, John Wiley & Sons. Inc, 2002

2. Willis J. Tompkins " Biomedical Digital Signal Processing", EEE, PHI, 2004
   D C Reddy "Biomedical Signal Processing: Principles and Techniques", Tata McGraw-Hill Publishing Co. Ltd, 2005
3. J G Webster "Medical Instrumentation : Application & Design", John Wiley & Sons Inc., 2001 C Raja Rao, S K Guha "Principles of Medical Electronics and Biomedical Instrumentation", Universities Press, 2001
4. AV Oppenheim and RW Shafer "Discrete-time Signal Processing", Prentice Hall, Englewood Cliffs, NJ, 1989.
   Steven M. Kay, "Modern spectral estimation theory and application ", Prentice Hall, Englewood Cliffs, NJ, 1988.

Course Code	Course Title						Core / Elective
PE807EE	**POWER PLANT DESIGN AND SAFETY MANAGEMENT**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
PC506EE	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To acquire good knowledge of process and its management strategies.
- To acquire good knowledge of process documentation and its safety related issues.
- To understand the basics of security issues of various process plants.

Course Outcomes

At the end of the course students will be able to

1. Model conceptual and methodological framework for describing a process and its management strategies
2. Learn effective documentation and auditing techniques for I & C plants
3. Learn the art of selecting safe zones for setting up of process control plants
4. Apply the process safety management tools and techniques in real time projects and plants.
5. Emphasis on security aspects like network security control centre and work station design and its related security

Unit –I

Overall plant design: Auditing existing plants for updating, project management and documentation, operator training, commissioning and start up, historical data storage and evaluation, Integration of process data with maintenance systems.

UNIT-II

Designing a Safe Plant: Hazardous area classification: Division classification and zone classification systems, Intrinsic safety rules for field bus installations: Intrinsic safety, Entity concept, Field bus intrinsically safe concept with examples, purging and inerting systems: Types of purge systems, Purge flow regulators.

UNIT-III

Process Safety Management: Elements of process safety management, Process hazard analysis, The HAZOP concept, Training with documentation, Incident analysis and reports, Emergency response plan, Issues in protective system technology, High integrity pressure protection system: code requirements and standards, HIPPS justification, device integrity architecture.

UNIT-IV

Network Security : Physical security, security policies, encrypt to protect network data, operating system security, login and password security, protection from viruses, digital certificates, securing the network with fire walls, Intelligent alarm management.

UNIT-V

Control Centre and Work Station Design: Operator interface evolution, Virtual reality tools for testing control room concepts, upgrading the control room, manufacturing platforms and work stations, workstation hosts: design concepts and classification.

Suggested Reading :

1. B.G.Liptak, Instrument engineer's handbook – Process Software and Digital Networks.

Course Code	Course Title						Core / Elective
PE804EE	**Power Quality (Professional Elective – IV)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- The student able to learn and understand the importance of power quality, different power quality issues and their effects in power system network

Course Outcomes:

On successful completion of course, students will be able to:

2. Describe the different PQ disturbances and state remedies to improve PQ.
3. Determine voltage sag for different network configurations.
4. Demonstrate the effect of ASD systems on power quality and the effect of voltage sags on operation of various electrical machines.
5. Evaluate harmonic levels for distribution systems.
6. Describe power quality monitoring and measuring techniques.

UNIT-I

Introduction: Introduction of the Power Quality (PQ) problem, Terms used in PQ: Voltage Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Remedies to improve power quality, power quality monitoring. Power Quality Data: Data collection, Data analysis, Database structure, Creating PQ databases, Processing PQ data.

UNIT-II

Voltage Sag – Characterization: Voltage sag – definition, causes of voltage sag, voltage sag magnitude, monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, Meshed systems, voltage sag duration. Three phase faults, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

UNIT-III

PQ Considerations in Industrial Power Systems: Adjustable speed drive (ASD) systems and applications, mitigation of harmonics. Characterization of voltage sags experienced by three-phase ASD systems: Types of sags and phase - angle jumps. Effects of momentary voltage dips on the operation of induction and synchronous motors. Voltage sag coordination for reliable plant operation.

UNIT-IV

Effects of Harmonics on Power Quality: Harmonic analysis of industrial customers, technical barriers in ASDs. Methods of evaluation of harmonic levels in industrial distribution systems. Harmonic effects on transformers. Impact of distribution system capacitor banks on PQ. Guidelines for limiting voltage harmonics.

UNIT-V

Power Quality Monitoring: Introduction, site surveys, Transducers, IEC measurement techniques for Harmonics, Flicker, IEC Flicker meter.

Suggested Reading:

1. Math H.J. Bollen, Understanding Power Quality Problems, IEEE Press, 1999.
2. Roger C. Dugan, MarkF. McGranaghan, Surya Santoso, H.WayneBeaty, Electrical Power Systems Quality, Second Edition, Tata McGraw-Hill Edition.
3. C. Sankaran, Power Quality, CRC Press, 2002.

Course Code	**Course Title**						**Core/Elective**
PC852EE	**PROCESS INSTRUMENTATION LAB**						**Core**
Prerequisite	**L**	**T**	**D**	**P**	**CIE**	**SEE**	**Credits**
PC406EE	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives:

- 1.To experimentally verify the principle and characteristics of various controllers.
- 2.To learn and understand the closed loop systems with various controller.

Course Outcomes:

On successful completion of this course student will be able to

1. Explain the characteristics and significance of final control elements
2. Tune the controllers and improve the performance of the process
3. Implement control system using PLC in Process automation
4.

1. Calibration of Current to Voltage and Voltage to Current Converter
2. Calibration of Current to Pressure and Pressure to Current Converters
3. Calibration of Temperature Control loop
4. Calibration of Pressure Control loop
5. Calibration of Flow Control loop
6. Calibration of Level Control loop
7. Application of PLC in Process Control
8. Tuning of Control Modes (P, PI, PID)
9. Study of Control Value Characteristics
10. Calibration of Pressure Gauge by using Dead Weight Tester
11. Application of Solenoid Valve in Process Control
12. Ratio Control System
13. Study of Interacting & Non-Interacting Systems
14. Calibration of Pneumatic Amplifier

15. Hydraulic logic Controllers – AND, OR, NOR, NAND Gates & Inverters

16. Measurement of Voltage, Temperature, Pressure & Flow using Hall Effect Sensors

***NOTE*:** ATLEAST 10 EXPERIMENTS SHOULD BE CONDUCTED IN THE SEMESTER

Suggested Reading:

1. G. Stephanopoulos, Chemical Process Control-An Introduction to Theory and Practice Prentice Hall of India, New Delhi, 2nd Edition, 2005.
2. D.R. Coughanowr, Process Systems Analysis and Control, McGraw Hill, Singapore, 2nd Edition, 1991.
3. B.W. Bequette, Process Control Modeling, Design and Simulation, Prentice Hall of India

Course Code	Course Title						Core / Elective
PW861EE	**Project Work- II**						**PW**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	**-**	**-**	**-**	**6**	**50**	**100**	**8**

Course Objectives

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic Literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas .

Course Outcomes:

1. demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
2. evaluate different solutions based on economic and technical feasibility
3. effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The aim of project work –II is to implement and evaluate the proposal made as part of project - I. Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

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

- Re-grouping of students - deletion of internship candidates from groups made as part of project work-I
- Re-Allotment of internship students to project guides
- Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 1st week of VIII semester so that students get sufficient time for completion of the project.

All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for 25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction.

Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Excellent / Good / Satisfactory / Unsatisfactory.

Note: Three periods of contact load will be assigned to each Project guide

FACULTY OF ENGINEERING

Scheme of Instruction & Examination

(CBCS Curriculum for the Academic Year 2019-2020)

and

Syllabi

B.E. VII and VIII Semester

of

Four Year Degree Programme

In

Electronics and Communication Engineering

(With effect from the academic year 2019– 2020)

(As approved in the faculty meeting held on 25-06-2019)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad – 500 007

2019

SCHEME OF INSTRUCTION & EXAMINATION
(ELECTRONICS AND COMMUNICATION ENGINEERING)
B.E. VII – SEMESTER

S. No	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
1	**PC701EC**	Embedded System	3	1	-	4	30	70	4	3
2	**PC702EC**	VLSI Design	3	1	-	4	30	70	4	3
3	**PC703EC**	Microwave Techniques	3	1	-	4	30	70	3	3
4	**PE – II**	Professional Elective-II	3	-	-	3	30	70	3	3
5	**PE – III**	Professional Elective-III	3	-	-	3	30	70	3	3
6	**OE – II**	Open Elective-II	3	-	-	3	30	70	3	3
7		Industrial Administration and Financial Management	3	-	-	3	30	70	3	3
Practical/Laboratory courses										
8	**PC751EC**	Microwave Lab	-	-	2	2	25	50	3	1
9	**PC752EC**	Electronic Design & Automation Lab	-	-	2	2	25	50	3	1
10	**PC753EC**	Project Seminar	-	-	2	2	25	-	-	1
11	**SI671EC**	Summer Internship*	-	-	-	-	50	-	-	2
		Total	**21**	**3**	**6**	**30**	**335**	**590**		**26**

MC: Mandatory Course **SI:** Summer Internship **HS:** Humanities & Social Sciences
L: Lectures **T:**Tutorial **P:**Practical **D:**Drawing
PC: Professional Course **PE: Professional Elective** **OE: Open Elective**
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note

1. Each contact hour is a clock hour

2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

*Marks and Credits for the summer internship will be awarded in this semester and they are just indicated in the previous semester.

Professional Elective-II		
S.No.	**Course Code**	**Course Title**
1.	PE771EC	Mobile and Cellular Communications
2.	PE772EC	Speech Signal Processing
3.	PE773EC	Electronic Measurements and Instrumentation
4.	PE774EC	Digital Signal Processor Architectures

Professional Elective-III		
S.No.	**Course Code**	**Course Title**
1.	PE775EC	Field Programmable Gate Arrays
2.	PE776EC	Internet of Things
3.	PE777EC	Neural Networks
4.	PE778EC	Satellite Communications

Open Elective-II		
S.No.	**Course Code**	**Course Title**
1.	OE701EC	Principles of Electronic Communications
2.	OE702EC	Fundamentals of IOT

Course Code	Course Title						Core / Elective
PC701EC	**EMBEDDED SYSTEM**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
MPMC PC603EC COA PC505EC	3	1	-	-	30	70	3

Course Objectives:

- Understand embedded systems, hardware and software components and design process of embedded system.
- List the RISC features of ARM core and study its architecture and instruction set.
- Acquire the knowledge about serial, parallel bus communication protocols and internet enabled systems-network protocols.
- Know about the steps, issues in the embedded system development process and different techniques for downloading embedded firmware into hardware.
- Familiarize with the different IDEs for firmware development for different family of processors/controllers and learn about different tools and techniques for embedded hardware debugging.

Course Outcomes:

1. Understand the fundamentals of the embedded system design
2. Enumerate the instruction set of ARM Processor by studying the architecture of ARM core
3. Acquire knowledge on the serial, parallel and network communication protocols.
4. Learn the embedded system design life cycle and co-design issues.
5. List the various embedded software development tools used in the design of embedded system for various applications.

UNIT –I

Introduction to Embedded Systems: Classification, Embedded Processor in a system, Embedded Hardware and Software: Processor embedded into a system, Processor selection for Embedded System, Embedded System-On–Chip, Design process in Embedded System, Characteristics and quality attributes of embedded systems, Design metrics and challenges in Embedded System design.

UNIT-II

The Arm Processor Fundamentals and Instruction set: RISC concepts with ARM Processors, Registers, Current Program status register, pipeline ,Exception, Exceptions, Conditional execution, Interrupts and vector table, Core extensions, Architectural Revisions, Arm processors Families.

Introduction to ARM Instruction Set: Data processing instructions, Branch instructions, Data transfer instructions, Software interrupt, and Program status register instructions.

UNIT-III

Serial Bus Communication protocols: I^2C, CAN, USB, Fire wire-IEEE 1394 Bus standard, advanced serial high speed buses. Parallel Bus device protocols: ISA, PCI, PCI-X, ARM Bus, Advanced parallel high speed buses. Internet Enabled Systems-Network protocols: HTTP, TCP/IP, Ethernet.

UNIT-IV

Embedded Software Development Process and Tools: Embedded System design and co-design issues in system development process, Design cycle in the development phase for an Embedded Systems.Embedded software development tools: Host and Target Machines, Linker/Locators for embedded software, Embedded Software into the Target system.

UNIT-V

Testing Simulation and Debugging Techniques and Tools: Integration and testing of embedded hardware, testing methods, debugging techniques, Laboratory tools and target hardware debugging: Logic Analyzer, simulator, emulator and In circuit emulator, IDE, RTOS Characteristics, Case Study: Embedded Systems design for automatic vending machines and digital camera.

Suggested Reading:

1. Raj Kamal, *"Embedded Systems-Architecture, Programming andDesign," 2*/e, TMH, 2012.
2. Shibu K V, "Introduction to Embedded systems", 1/e, McGraw Hill Education, 2009.
3. David E.Simon, *"An Embedded software primer,"* Pearson Education, 2004.
4. Steve Furber, *"ARM System on chip Architecture,"* 2/e, Pearson Education.
5. Andrew N.Sloss, Dominic Symes, Chris Wright,"ARM SYSTEM Developer's Guide Designing and Optimizing System Software" Elsevier 2015

Course Code	Course Title						Core / Elective
PC702EC	**VLSI DESIGN**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
EDPC302EC STLDPC303EC DSDPC506EC	3	1	-	-	30	70	3

Course Objectives:

- Explain electrical properties of MOS and BiCMOS devices to analyze the behavior of inverters designed with various loads.
- Give exposure to the design rules to be followed to draw the layout of any logic circuit.
- Provide concept to design different types of Combinational and arithmetic circuits.
- Learn to design sequential logic circuits using CMOS transistor.
- Study the small signal model various amplifiers.

Course Outcomes:

1. Analyze modes of operation of MOS transistor and its basic electrical properties
2. Draw stick diagrams and layouts for any MOS transistors and calculate the parasitic R&C
3. Analyse the operation of various arithmetic circuits.
4. Design sequential logic circuits using CMOS transistors
5. Understand the small signal model and characteristics of CMOS amplifiers.

UNIT - I

INTRODUCTION: Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS technologies-Fabrication Process.

BASIC ELECTRICAL PROPERTIES : Basic Electrical Properties of MOS and Bi-CMOS Circuits: Ids-Vds relationships, MOS transistor threshold Voltage, gm, gds, figure of merit; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

UNIT - II

VLSI CIRCUIT DESIGN PROCESSES: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

GATE LEVEL DESIGN : Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Basic circuit concepts, Sheet Resistance RS and its concept to MOS, Area Capacitance Units, Calculations – RC Delays.

UNIT III

SUBSYSTEM DESIGN: Shifters, Adders: Carry skip, carry select, square root carry select , Manchester; ALU, Multipliers: Booth, Baugh-Woolley, High Density Memory Elements: SRAM, DRAM, ROM Design.

UNIT IV

SEQUENTIAL LOGIC DESIGN: Behavior of Bi-stable elements, SR Latch, Clocked Latch and Flip-flop circuits, CMOS D latch and Edge triggered Flip flops.

CMOS TESTING : CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chip level Test Techniques, System-level Test Techniques, Layout Design for improved Testability.

UNIT V

ANALOG VLSI DESIGN: Small signal model of MOSFETs, Simple CMOS current mirror, Common Source Amplifier, Source follower, Common Gate Amplifier, Source degenerated current mirror, Casode and Wilson current mirrors.

Suggested Reading:

1. Kamran Eshraghian, Eshraghian Dougles and A. Pucknell, “Essentials of VLSI circuits and systems”, PHI, 2005 Edition.
2. Weste and Eshraghian, “Principles of CMOS VLSI Design”, Pearson Education, 1999.
3. John .P. Uyemura, “Introduction to VLSI Circuits and Systems”, JohnWiley, 2003.
4. John M. Rabaey, “Digital Integrated Circuits”, PHI, EEE, 1997.
5. Wayne Wolf,” Modern VLSI Design”, Pearson Education, 3rd Edition, 1997.

Course Code	Course Title						Core / Elective
PC703EC	**MICROWAVE TECHNIQUES**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
AWP PC602EC EMTL PC404EC	3	1	-	-	30	70	3

Course Objective:

- Understand the concept of Guided waves and its propagation in different modes (TE, TM, and TEM) between parallel planes and to find out applications of different parameters.
- Use of the concept of TE, TM & TEM waves in Waveguides (Rectangular and Circular) and evaluate different parameters &understand the operation of Cavity Resonators.
- Understand the concept of Microwave circuit and evaluate Scattering parameters of microwave components.
- Understand the high frequency limitations of conventional tubes and principle of bunching and velocity modulation analyze the operation of microwave tubes
- Understand principle and operation of Microwave solid state devices &evaluate the characteristics of devices & concept of strip lines, slot lines and fin lines.

Course Outcomes:

1. Analyze the propagation of Guided waves in different modes between parallel planes.
2. Evaluate different parameters (Like impedance, attenuation and quality factor.) for Rectangular & Circular Waveguides &Cavity Resonators.
3. Determine Scattering parameters of different microwave components and analyze their properties.
4. Integrate the concept of bunching and velocity modulation to summarize the operation of microwave tubes and the high frequency limitations of conventional tubes.
5. Analyze the principle, operation and characteristics of different microwave solid state devices.

UNIT-I

Guided Waves: Propagation of TE, TM and TEM waves between parallel planes. Velocity of propagation, wave impedance, attenuation in parallel plane guides.

UNIT-II

Waveguides: TE and TM waves in rectangular and circular waveguides, Wave Impedance, Characteristic Wave Impedance, Attenuation and Q of waveguides. Cavity resonators, resonant frequency and Q, Applications of cavity resonator.

UNIT-III

Microwave Circuits and Components: Concept of Microwave circuit, Normalized voltage and current, Introduction to scattering parameters and their properties, S parameters for reciprocal and Non-reciprocal components- Magic Tee, Directional coupler, E and H Plane Tees and their properties, Attenuators, Phase Shifters, Isolators and circulators.

UNIT-IV

Microwave Tubes: High frequency limitations of conventional tubes, Bunching and velocity modulation, mathematical theory of bunching, principles and operation of two cavity, multi cavity and Reflex Klystron.

Theory of crossed field interaction: Principles and operation of magnetrons and crossed field amplifiers, TWT and BWO.

UNIT-V

Microwave Solid State Devices: Principles of operation, characteristics and applications of Varactor, PIN diode, GUNN diode and IMPATT diode.

Elements of strip lines, micro strip lines, slot lines and fin–lines.

Suggested Readings:

1. E. C. Jordan & Keith G. Balmain, "Electromagnetic Waves and Radiating Systems", 2/e, Pearson Education, 2006.
2. Samuel Y. Liao, "Microwave Devices and Circuits", 3/e, Pearson Education, 2003.
3. R. E. Collins, "Foundations for Microwave Engineering", 2/e, Wiley India Pvt. Ltd., 2012.
4. Annapurna Das and Sisir K. Das " Microwave Engineering ", McGraw Hill Education, Third edition, 2014
5. Skalnik, Krauss, Reich, *Microwave principles*, East West Press, 1976

Course Code	Course Title						Core / Elective
	INDUSTRIAL ADMINISTRATION AND FINANCIAL MANAGEMENT						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
MEA HS901MB	3	-	-	-	30	70	3

Course Objectives

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

Course Outcomes

1. 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 appreciate 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 organization.

UNIT – I

Industrial Organization: Types of various business organisations, Organisation structures and their relative merits and demerits. Functions of management.

Plant Location and Layouts: Factors affecting the location of plant and layout. Types of layouts and their merits and demerits.

UNIT – II

Work Study: Definitions, objectives of method study and time study. Steps in conducting method study. Symbols and charts used in method study. Principles of motion economy. Calculation of standard time by time study and work sampling. Performance rating factor. Types of ratings. Jobs evaluation and performance appraisal. Wages, incentives, bonus, wage payment plans.

UNIT – III

Inspection and Quality Control: Types and objectives of inspection S.Q.C., its principles. Quality control by chart and sampling plans. Quality circles, introduction to ISO.

UNIT – IV

Optimization: Introduction ot linear programming and its graphical solutions. Assignment problems.
Project Management: Introduction to CPM and PERT .Determination of critical path.
Material Management: Classification of materials, Materials planning.
Duties of purchase manager. Determination of economic ordering quantities. Types of materials purchase.

UNIT – V
Cost Accounting: Elements of cost. Various costs. Types of overheads. Breakeven analysis and its applications. Depreciation. Methods of calculating depreciation fund. Nature of financial management. Time value of money .Techniques of capital budgeting and methods. Cost of Capital, Financial leverage.

Suggested Reading

1. Pandey I.M., "Elements of Financial Management", Vikas Pulications House, New Delhi, 1994.
2. Khanna O.P., "Industrial Engineering and Management", Dhanapat Rai & Sons.
3. Marshall/Bansal, "Financial Engineering", PHI.
4. Keown, "Financial Management", 9/e, PHI.
5. Chandra Bose,"Principles of Management &Administration", PHI.

Course Code	Course Title						Core / Elective
PC751EC	**MICROWAVE LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1

Course objectives:

- Understand the characteristics of RKO and Gunn oscillator.
- Measurement of frequency and wavelengths would be learnt by the student.
- VSWR various TEES would be understood by the student.
- Radiation pattern would be learnt by the student for horn antenna.
- How to Create, Simulate and analyze the different types of Microstrip Antennas by using EM simulation software.

Course Outcomes

1. Analyze frequency, Wave length, SWR and Impedance for Reflex klystron Oscillator by using its equation.
2. Evaluate of mode characteristics of Reflex klystron and V-I Characteristics of Gunn diode.
3. Analyze of the characteristics of Circulator, Isolator, Directional Coupler, Tees like (Magic tee, E & H plane tees) using the Scattering parameters.
4. Generate the Radiation pattern of different antennas like Yagi-Uda and Horn Antenna and measure the gain of the antennas.
5. Familiarize with the EM simulation software

List of experiments

1. Characteristics of Reflex Klystron oscillator, finding the mode numbers and efficiencies of different modes.
2. Characteristics of Gunn diode oscillator, Power Output Vs Frequency, Power Output Vs Bias Voltage.
3. Measurement of frequency and Guide wavelength calculation:
    a. Verification of the relation between Guide wavelength, free space wavelength and cutoff
       Wavelength of X- band rectangular waveguide.
    b. Verification of the straight line relation between $(1/\lambda g)^2$ and $(1/\lambda 0)^2$ and finding the dimension of the guide.
4. Measurement of low and high VSWRs: VSWR of different components like matched terminals, capacitive and inductive windows, slide screw tuner for different heights of the tuning posts etc.
5. Measurement of impedance for horn antenna, Matched load and slide screw tuner.
6. To find the S-parameters of Directional coupler.
7. To find the S-parameters of Tees: E plane, H plane and Magic Tee.

8. To find the S-parameters of Circulator.
9. Measurement of radiation patterns for basic microwave antennas like horn and parabolic reflectors in E-plane and H-plane. Also to finding the gain, bandwidth and beamwidth these antennas.
10. How to Create, Simulate and Analyze the Dipole Antenna Structure by using EM simulation software
11. How to Create, Simulate and Analyze a Microstrip Rectangular Patch Antenna by using EM simulation software
12. How to Create, Simulate and Analyze a Probe Feed Patch Antenna by using EM simulation software
13. How to Create, Simulate and Analyze a The Triangular Microstrip Antenna by using EM simulation software

NOTE: At least 10 experiments to be carried out during the semester

Suggested Readings:

1. M L Sisodia& G S Raghuvanshi, "Basic Microwave Techniques and Laboratory Manual", New Age International (P) Limited, Publishers.
2. Ramesh Garg, Prakash Bhartia, Inder Bahl and Apisak Ittipiboon "Microstrip Antenna Design HandBook" Artech House Publishers, 2001

Course Code	Course Title						Core / Elective
PC752EC	**ELECTRONIC DESIGN AND AUTOMATION LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	25	50	1

Course Objectives:

- Familiarize with the usage of IDE tools and execution of programs using ARM processor.
- Know about the usage of various devices like LCD, Temperature sensor, Buzzer, Stepper Motor by interfacing them to LPC2148.
- Understand the designing and implementation of combinational and sequential logic circuits using Verilog HDL.
- Study of Mentor Graphics Tools
- Implement basic gates at transistor level

Course Outcomes:

1. Familiarize with the usage of IDE tools and program using various on chip like LCD, Temperature sensor, Buzzer, Stepper Motor by interfacing them to ARM Processor
2. Design the digital logic circuits in various modeling styles using Verilog HDL
3. Familiarize with VLSI CAD tools like Mentor Graphics / Cadence
4. Implement basic gates at transistor level
5. Implement the digital circuits at transistor level.

PART-A

Interfacing Programs using embedded C on ARM Micro controller Kit

1. Program to interface 8-Bit LED and switch interface
2. Program to implement Buzzer interface on IDE environment
3. Program to display message in a 2 line x 16 characters LCD display and verify the result in debug terminal
4. Stepper motor interface
5. ADC & Temperature sensor LM35 interface
6. Transmission from kit and reception from PC using serial port.

PART-B

Implementation of programs using Verilog HDL code on FPGA Board

1. Adders / Subtractors
2. Multiplexer / Demultiplexer
3. Flip flops
4. Counters/Registers
5. Vending Machine controller
6. Multipliers

PART C

Transistor Level implementation of CMOS circuits using VLSI CAD tool

1. Basic Logic Gates: Inverter, NAND and NOR
2. Half Adder and Full Adder
3. 4:1 Multiplexer
4. 2:4 Decoder

Note: A minimum of 10 experiments to be performed and at least 3 experiments from each part to be performed.

Course Code	Course Title						Core / Elective
PC753EC	**PROJECT SEMINAR**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	25	-	1

Course Objectives:

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic Literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes:

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of the state of the art topics in a broad area of his / her specialization.

Project seminar topics may be chosen by the student with advice and approval from the faculty members. Students are to be exposed to the following aspects of seminar presentation.

- Literature Survey
- Organization of the material
- Presentation of OHP slides / PC presentation
- Technical writing Each

student is required to:

1. Submit a one-page synopsis before the seminar talk for display on the notice board.
2. Give a 20 minutes presentation through OHP, PC, Slide project followed by a 10 minutes discussion.
3. Submit a report on the seminar topic with list of references and slides used. Seminars are to be scheduled from the 3rd week of the semester to the last week of the semester and any change in schedule should be discouraged..

For award of sessional marks students are to be judged by the last two faculty members on the basis of an oral and written presentation as well as their involvement in the discussions.

Course Code	Course Title						Core / Elective
SI671EC	**SUMMER INTERNSHIP**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	-	50	-	2

Course Objectives:

- To give an experience to the students in solving real life practical problems with all its constraints.
- To give an opportunity to integrate different aspects of learning with reference to real life problems.
- To enhance the confidence of the students while communicating with industry engineers and give an opportunity for useful interaction with them and familiarize with work culture and ethics of the industry.

Course Outcomes:

1. Able to design/develop a small and simple product in hardware or software.
2. Able to complete the task or realize a prespecified target, with limited scope, rather than taking up a complex task and leave it.
3. Able to learn to find alternate viable solutions for a given problem and evaluate these alternatives with reference to prespecified criteria.
4. Able to implement the selected solution and document the same.

Summer Internship is introduced as part of the curricula for encouraging students to work on problems of interest to industries. A batch of two or three students will be attached to a person from an Electronics Industry / R & D Organization / National Laboratory/Any other program approved by the department for a period of 8 weeks. This will be during the summer vacation following the completion of the VI semester course. One faculty member will act as an internal guide for each batch to monitor the progress and interacts with the Industry guide.

After the completion of the project, students will submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the department. Award of sessionals are to be based on the performance of the student at the work place to be judged by industry guide and internal guide (25 Marks) followed by presentation before the committee constituted by the department (25 Marks). One faculty member will co- ordinate the overall activity of Summer Internship.

***Students have to undergo summer internship of 6 Weeks duration at the end of semester VI and credits will be awarded after evaluation in VII semester**

PROFESSIONAL ELECTIVE-II

Course Code	Course Title						Core / Elective
PE771EC	**MOBILE AND CELLULAR COMMUNICATIONS**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	30	70	3

Course objectives:

- To understand the concept and implementation of frequency reuse and Handoff techniques and to analyze interference and capacity enhancement.
- To appreciate the factors influencing outdoor and indoor propagation systems
- To analyze various multiple access protocols based on their merits and demerits.
- To visualize the system architectures and implementation of GSM and CDMA based mobile communication systems.
- To understand the concepts in various Mobile Technologies

Course Outcomes:

- Understand the method of selection and reuse of a set of frequency channels, Base station requirement, signals required for communication and hand over between Base stations
- Appreciate and understand the methods of electromagnetic wave propagation in cellular communication. The evaluation of the electromagnetic energy reaching the mobile unit.
- Identify different a methods of mobile access technologies and which of them suitable for mobile cellular solutions. Understand process used for Bluetooth, Zigbee like low power devices
- Explain features, authentication, operational details of GSM and CDMA mobile cellular systems along with data frame structure details.
- The development and limitation of the preliminary and advanced generation of mobile systems. Present trends in Cellular communications and the future communication requirements.

UNIT-I

Basic Cellular system and its operation, frequency reuse, channel assignment strategies, Handoff process, factors influencing handoffs, handoffs in different Generations, Interference and system capacity, Cross talk, Enhancing capacity and cell coverage, Trunked radio system. Manual and Automatic Electronic Exchanges.

UNIT-II

Free space propagation model, three basic propagation mechanisms, practical link budget design using path loss models, outdoor propagation models: Durkin's model and indoor propagation model, partition losses. Small scale multipath propagation, Parameters of mobile multipath channels, types of small scale fading. Cell Tower Antenna/radiation pattern, Mobile antennas/ radiation patterns

UNIT-III

Data multiple access Technologies in Communication: FDMA, TDMA, SSMA, FHMA, CDMA, SDMA, Packet radio protocols, CSMA, Reservation protocols time Frame details.

UNIT-IV

GSM: Services and Features, System architecture, Radio Sub system, Channel Types, Frame structure and Signal processing.

CDMA: Digital Cellular standard IS-95, Forward Channel, Reverse Channel.

UNIT-V

Comparison of Mobile communication Technologies: 1G, 2G and 2.5G, technology Features of 3G and 4G and 5G, WLAN, Bluetooth, PAN, Trends in Radio and Personal Communications, UMTS system architecture and Radio Interface.

Suggested Reading:

1. Theodore.S.Rappaport, "Wireless Communications: Principles and Practice," 2/e, Pearson Education, 2010.
2. William. C.Y. Lee, "Mobile Communication Engineering," 2/e, Mc-Graw Hill, 2008.
3. T.L. Singal "Wireless Communication Systems," 1/e, TMH Publications, 2010.
4. William.C.Y.Lee, *"*Mobile Cellular Telecommunications: Analog and Digital Systems*,"* 2/e, Mc-Graw Hill, 2011.

Course Code	Course Title						Core /Elective
PE772EC	**SPEECH SIGNAL PROCESSING**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
DIP PE671EC	3	-	-	-	30	70	3

Course Objectives:
- Understand the basic mechanism of human speech production.
- Understand digital representation of speech waveforms.
- Understand Short-time analysis and Synthesis techniques.
- Understand Speech Synthesizers.
- Understand the various problems with Automatic speech recognition.

Course Outcomes:
- Able to grasp the basic mechanism of human speech production.
- Able to understand digital representation of speech waveforms.
- Able to do Short-time analysis and Synthesis techniques.
- Able to analyze Speech Synthesizers.
- Able to understand the various problems with Automatic speech recognition

UNIT I
Introduction to Speech Processing: The mechanism of Speech production, Acoustic Phonetics, Source-Filter model of speech production.
Representation of Speech waveforms: Delta modulation, Adaptive delta modulation, Differential PCM, Adaptive differential PCM.

UNIT II
Time-domain models for Speech processing: Short -Time Energy function, Zero crossing rate, End point detection, Pitch Period Estimation, Vector quantization. Format Tracking

UNIT III
Speech Signal Analysis: Short-Time Fourier analysis, Auto correlation function, Linear Predictive Analysis, Pitch Synchronous Analysis.
Homomorphic Speech Processing: The Complex Cepstrum of Speech and its properties, Applications of Cepstral Processing

UNIT IV
Speech Synthesis: Format Synthesis, Linear Predictive Synthesis, Introduction to Text-to-speech, Articulatory speech synthesis.
Speech Coders: Sub-band coding, Transforms coding, Channel decoder, Formant decoder, Linear Predictive decoder, Vector Quantizer coder.

UNIT V
Automatic Speech Recognition: Problems in Automatic speech Recognition, Dynamic warping, Hidden Markov models, Speaker Identification / verification.

Suggested reading:

1. L R Rabiner & R W Schafer, *"*Digital Processing of Speech Signals", PHI, 1978.
2. F J Owens, "Signal Processing of Speech", Macmillan, 2000.
3. Papamchalis, "Practical Approaches to Speech Coding", PHI, 1987.
4. Daniel Jurefskey & Jemes H. Martin, "*Speech and Language Processing*", Pearson Education, 2003.
5. Thomas W. Parsons, "*Voice and Speech Processing*", Mc GRAWHILL, 1986.

Course Code	Course Title						Core / Elective
PE773EC	**ELECTRONIC MEASUREMENTS AND INSTRUMENTATION**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ED PC302EC LICA PC501EC	3	-	-	-	30	70	3

Course Objectives

- Understand the different standards of measurements.
- Study different types of transducers.
- List various types of measurements and thermometers.
- Learn the design of digital voltmeters
- Study various types of bio-medical instruments.

Course Outcomes

1. Describe characteristic of an instrument and state different Standards of measurements
2. Identify and explain different types of Transducers.
3. Draw and Interpret types of transducers.
4. Design and analyze the digital voltmeters and Prioritize the instruments.
5. Identify and classify types of Biomedical instruments.

Unit-I

Accuracy, Precision, Resolution and Sensitivity. Errors and their types. Standards of measurement, classification of standards, IEEE standards.

Unit-II

Transducers: classification, factors for selection of a transducer, transducers for measurement of velocity, acceleration. Passive electrical transducers- Strain gauges and strain measurement, LVDT and displacement measurement, capacitive transducer and thickness measurement. Active electrical transducers: Piezo electric, photo conductive, photo voltaic and photo emissive transducers.

Unit-III

Characteristics of sound, pressure, power and loudness measurement. Microphones and their types. Temperature measurement, resistance wire thermometers, semiconductor thermometers and thermocouples.

Unit-IV

Block diagram, specification and design considerations of different types of DVMs. Spectrum analyzers. The IEEE488 or GPIB Interface and protocol.

Delayed time base oscilloscope and Digital storage oscilloscope. Introduction to virtual instrumentation, SCADA. Data acquisition system block diagram.

Unit-V

Biomedical Instrumentation: Human physiological systems and related concepts. Bio-potential electrodes Bio-potential recorders – ECG, EEG, EMG, X- ray machines and CT scanners, magnetic resonance and imaging systems, Ultrasonic Imaging systems.

Suggested Reading:

1. Albert D. Helfric, and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI, 2010.
2. H S Kalsi, "Electronic Instrumentation", 3/e, TMH, 2011.
3. Robert A Witte, "Electronic Test Instruments: Analog and Digital Measurements", 2/e, 2002.
4. Nakra B.C, and Chaudhry K.K., "Instrumentation, Measurement and Analysis", TMH, 2004.
5. Khandpur. R.S., "Handbook of Bio-Medical Instrumentation", TMH, 2003.

Course Code	Course Title						Core/Elective
PE774 EC	**DIGITAL SIGNAL PROCESSOR ARCHITECTURES**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
DSP PC503 EC	3	-	-	-	30	70	3

Course Objectives:

- To study the importance of DSPs and the numeric formats
- To analyse the implementation considerations.
- To elaborate on architectures of PDSPs.
- To compare architectures of different types of DSPs.
- To understand the concepts of Memory and peripheral & device I/O interfacing.

Course Outcomes:

1. Comprehend the importance of DSPs.
2. Highlight their implementation considerations.
3. Explain the architectures for PDSPs.
4. Compare various architectures of DSPs.
5. Integrate DSP programmable devices with external peripherals and devices.

UNIT-I:

Major features of DSP Processors: Differences between DSP and other general purpose processor architectures, their comparison and need for special ASPs, RISC and CISC CPUs.
Data representations and arithmetic, finite word length effects.

UNIT-II:

Implementation considerations: Real time implementation considerations. Hardware looping, Interrupts, Stacks, Relative Branch support, Pipelining and Performance, Pipeline Depth, Interlocking, Branch effects, Interrupt effects, Pipeline Programming models, sources of errors. DSP Tools – Assembler, debugger, c-compiler, linker, editor, Code Composer Studio.
Applications: Adaptive filtering, Spectrum analysis, Echo Cancellation modems, Voice synthesis and recognition.

UNIT-III:

Architectures for Programmable DSP devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues.

UNIT-IV:

Programmable Digital Signal Processors: Fixed point DSPs – Architecture of TMS 320C5X, C54X Processors, Addressing modes, Assembly instructions, Pipelining and on-chip peripherals. Floating point DSPs - Architecture of TMS320-1X-Data formats, Floating Point operations, Addressing Modes, instructions, pipelining and peripherals.
Overview of AD and Motorola DSP CPUs; Their comparison with TI CPUs.

UNIT-V:

Memory and I/O Interfacing (C54X): Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct Memory Access (DMA). Synchronous Serial Interface: A Multichannel buffered serial port (McBSP), a CODEC interface circuit. I/O interfacing with A/D converters.

Suggested Readings:

1. B. Venkataramani, M. Bhaskar, "Digital Signal Processors – Architecture, programming and Applications, Tata McGrawHill, 2nd ed., 2011.
2. Lapsley et al., "DSP Processor Fundamentals, Architectures & Features", S. Chand & Co, 2000.
3. Avtar Singh, S.Srinivasan, "Digital Signal Processing - Implementation using DSP Microprocessors with Examples from TMS32C54XX", Cengage Learning, 2004.
4. K. Shin, "DSP Applications with TMS 320 Family", Prentice Hall, 1987.
5. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing-Principles, Algorithms, and Applications", Prentice Hall of India, 2007.

PROFESSIONAL ELECTIVE-III

Course Code	Course Title						Core / Elective
PE775EC	**FIELD PROGRAMMABLE GATE ARRAYS**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
DSD PC506EC STLD PC303EC	3	-	-	-	30	70	3

Course Objectives:

- Understand the ASIC design flow and Programming Technologies
- Study different Architecture of FPGAS.
- Understand the FPGA physical Design Flow of FPGA
- Learn the placement and routing algorithms
- Enlist the verification and testing methods of digital circuits

Course Outcomes:

- Design of ASIC's using implementation tools for simulation and synthesis.
- Describe the architecture of FPGA's.
- Discuss physical design using FPGA's and CAD tools.
- Describe placement & routing algorithms.
- Analyze verification and testing of Digital circuits.

UNIT I

Introduction to ASIC's: Types of ASIC's, ASIC design flow, Economies of ASIC's, Programmable ASIC's: CPLD and FPGA. Commercially available CPLD's and FPGA's: XILINX, ALTERA, ACTEL. FPGA Design cycle, Implementation tools: Simulation and synthesis, Programming technologies. Applications of FPGAs

UNIT II

FPGA logic cell for XILINX, ALTERA and ACTEL ACT, Technology trends, Programmable I/O blocks, FPGA interconnect: Routing resources, Elmore's constant, RC delay and parasitic capacitance, FPGA design flow, Dedicated Specialized components of FPGAs

UNIT III

FPGA physical design, CAD tools, Power dissipation, FPGA Partitioning, Partitioning methods. Floor planning: Goals and objectives, I/O, Power and clock planning, Low-level design entry.

UNIT IV

Placement: Goals and objectives, Placement algorithms: Min-cut based placement, Iterative Improvement and simulated annealing.

Routing, introduction, Global routing: Goals and objectives, Global routing methods, Back-annotation. Detailed Routing: Goals and objectives, Channel density, Segmented channel routing, Maze routing, Clock and power routing, Circuit extraction and DRC.

UNIT V

Verification and Testing: Verification: Logic simulation, Design validation, Timing verification. Testing concepts: Failures, Mechanism and faults, Fault coverage.
Testing concepts: failures, mechanisms and faults, fault coverage, ATPG methods, and programmability failures.

Suggested Reading:

1. Pak and Chan, Samiha Mourad, *Digital Design using Field Programmable Gate Arrays*, Pearson Education, 1st edition, 2009.
2. Michael John Sebastian Smith, *Application Specific Integrated Circuits*, Pearson Education Asia, 3rd edition 2001.
3. S.Trimberger, Edr, *Field Programmable Gate Array Technology*, Kluwer Academic Publications, 1994.
4. John V.Oldfield, Richard C Dore, *Field Programmable Gate Arrays*, Wiley Publications.

<table>
<tr><td>Course Code</td><td colspan="4">Course Title</td><td colspan="2"></td><td>Core / Elective</td></tr>
<tr><td>PE776EC</td><td colspan="6">INTERNET OF THINGS</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>MPMC
PC603EC</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

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:

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

UNIT - I:

Introduction to Internet of Things: Definition and Characteristics of IoT, Physical Design of IoT: Things in IoT,IoT protocols, Logical Design of IoT: IoT functional Blocks, Communication Models, APIs, IoT enabling TEchnologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics (Ref 1)

IoT Applications: Smart Home, Smart Cities, Smart Environment, Smart Energy, Smart Retail and Logistics, Smart Agriculture and Industry, Smart Industry and smart Health (Ref1)

UNIT – II

Internet Principles and communication technology: Internet Communications: An Overview – IP,TCP,IP protocol Suite, UDP. IP addresses – DNS, Static and Dynamic IP addresses, MAC Addressess, TCP and UDP Ports, Application Layer Protocols – HTTP,HTTPS, Cost Vs Ease of Production, Prototypes and Production, Open Source Vs Closed Source. Prototyping Embedded Devices – Sensors, Actuators, Microcontrollers, SoC, Choosing a platform, Prototyping Hardware platforms – Arduino, Raspberry Pi. Prototyping the physical design – Laser Cutting, 3D printing, CNC Milling (Ref 2)

UNIT – III

API Development and Embedded programming: Getting started with API, Writing a new API, Real time Reactions, Other Protocols, Techniques for writing embedded code:Memory management, Performance and Battery Life, Libraries, Debugging. (Ref 2)

Developing Internet of Things: IoT design Methodology, Case study on IoT System for weather monitoring (Ref 1)

UNIT – IV:

IoT Systems - Logical Design using Python: Introduction to Python, Data Types and Structures, Control Flow, Functions, Modules, Packages, File Hnadling, Date/Time Operations., Classes, Python packages for IoT (Ref 1 and Ref 3)

IoT Physical Devices and Endpoints: Raspberry Pi, Interfaces of Pi, Programming pi with Python - Controlling LED and LDR using Pi with python programming.

UNIT – V:

Cloud computing and Data analytics and IoT Product Manufacturing: Introduction to Cloud storage models and Communication APIs, Amazon webservices for IoT, Skynet IoT Messaging Platform. Introduction to Data Analytics for IoT(Ref 1). Case studies illustrating IoT Design – Smart Lighting, Weather Monitoring, Smart Irrigation.(Ref 1) Business model for IoT product manufacturing, IoT Startups, Mass manufacturing, Ethical issues in IoT.(Ref 2)

Suggested Reading:

1. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , ArshdeepBahga, VPT Publisher, 1st Edition, 2014.
2. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally. Wiley India Publishers.
3. Fundamentals of Python, Kenneth A Lambert and B.L. Juneja, Cenage Learning
4. *Internet of Things* - Converging Technologies for smart environments and Integrated ecosystems, River Publishers.
5. *Internet of things* **-**A hands on Approach, Arshdeep Bahga, Universities press.

Course Code	Course Title						Core / Elective
PE777EC	**NEURAL NETWORKS**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PTSP PC403EC DIP PE671EC	3	-	-	-	30	70	3

Course Objectives:

- To understand the functioning of biological neuron and its electronic implementation using different Neuron models
- The activation & synaptic dynamics of Neural Networks & its distinction
- To understand the concepts of pattern recognition tasks as applied to Neural Networks
- The concepts of Perceptron Neural Networks & train different Feed forward Neural Networks
- To train different Feedback Neural Networks & their applications

Course Outcomes:

- To differentiate between Biological Neuron & Artificial Neuron and different Neuron Models
- To analyze activation & synaptic dynamics of Neural Networks
- To summarize the Pattern Recognition Tasks & different Neural Network memories
- To solve Perceptron XoR problem & write different training algorithms for Feed forward Neural Networks
- To understand & train different Feedback Neural Networks and their applications

Unit I

Introduction to Neural Networks, Description of Biological Neuron, Mathematical model of Artificial Neural Network, Classification of Neural Networks, Different Neuron models: McCulloch-Pitts Neuron model, Perceptron Neuron model and ADALINE Neuron model, Basic learning laws

Unit II

Activation and Synaptic dynamics of Neural Networks: Additive, Shunting and Stochastic activation models, Distinction between Activation and Synaptic dynamics models, Requirements of learning laws, Recall in Neural Networks.

Unit III

Pattern Recognition Tasks: Pattern association, pattern storage (LTM & STM), Pattern clustering and feature mapping, Neural Network Memory: Auto Associative Memory, Hetero Associative Memory, Bidirectional Associative Memory.

Unit IV

Feed Forward Neural Networks: Single layer & Multi layer Neural Networks, Peceptron Neural Networks solution of XoR problem, Perceptron Convergence Theorem, Back Propagation Neural Networks, its features, limitations & extensions, Kohonen Self-Organizing Networks & its applications

Unit V

Feedback Neural networks: Hopfield network, capacity and energy analysis of Hopfield Neural Network & its applications, Radial Basis Function Networks, its training algorithm & applications, Boltzmann machine, Boltzman learning law.

Suggested Reading:

1. B. Yeganaranarana, *Artificial Neural Networks*, Prentice Hall, New Delhi, 2007.
2. J.A.Freeman and D.M.Skapura, *Neural Networks Algorithms, Applications and Programming Techniques*, Addison Wesley, New York, 1999.
3. Simon Haykin, *Neural Networks (A Comprehensive Foundation)*, McMillan College Publishing Company, New York, 1994.
4. S.N. Sivanandam & M.Paul Raj, *Introduction to Artificial Neural Networks*, Vikas Publishing House Pvt Limited, 2009.
5. Richard O.Duda, Peter E Heart, David G.Stork, *Pattern Classification,* John Wiley & Sons 2002

Course Code	Course Title						Core / Elective
PE778EC	**SATELLITE COMMUNICATIONS**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
DC PC601EC	3	-	-	-	30	70	3

Course Objectives

- To understand basics of satellite communications
- To study various effects on satellite communications and to understand types of antennas used.
- To study various components in satellite and satellite TV systems.
- To analyze and design satellite communication link and study various access techniques.
- To study various applications of satellite communications in practical world.

Course Outcomes

- Explain principle, working and operation of satellite.
- Illustrate various effects on satellite communications and its antennas.
- Explain various components in satellite and satellite TV systems.
- Analyze and design satellite communication link
- Illustrate role of satellite in various applications

Unit I

A Brief History of Satellite Communications, Overview and Indian Scenario of Satellite Communications, Kepler's Laws, Definitions of Terms for Earth-Orbiting Satellites, Orbital Elements, Apogee and Perigee Heights, Orbit Perturbations - Effects of a non-spherical earth, Atmospheric drag

Unit II

Antenna Look Angles, The Polar Mount Antenna, Limits of Visibility, Near Geostationary Orbits, Earth Eclipse of Satellite, Sun Transit Outage, Launching Orbits, Atmospheric Losses, Ionospheric Effects, Rain Attenuation, Other Propagation Impairments, Antenna Polarization, Polarization of Satellite Signals, Cross-Polarization Discrimination, Ionospheric Depolarization, Rain Depolarization, Ice Depolarization, Horn Antennas, The Parabolic reflector, Offset feed, Double-reflector antennas

Unit III

Power Supply, Attitude Control - Spinning satellite stabilization, Momentum wheel stabilization, Station Keeping, Thermal Control, TT&C Subsystem, Transponders - The wideband receiver, the input demultiplexer, the power amplifier, The Antenna Subsystem.

Receive-Only Home TV Systems - The outdoor unit, the indoor unit for analog (FM) TV, Master Antenna TV System, Community Antenna TV System, Transmit-Receive Earth Stations

Unit IV

Equivalent Isotropic Radiated Power, Transmission Losses, The Link-Power Budget Equation, System Noise, Carrier-to-Noise Ratio, The Uplink - Saturation flux density, Input backoff, Downlink - Output back-off, Effects of rain – Uplink & Downlink rain-fade margin, Combined Uplink and Downlink C/N Ratio

Single Access, Preassigned FDMA, Demand-Assigned FDMA, Spade System, TDMA, Preassigned TDMA, Demand-assigned TDMA, Satellite-Switched TDMA, CDMA

Unit V

C-Band and Ku-Band Home Satellite TV, Digital DBS TV, DBS- TV System Design, DBS-TV Link Budget, Error Control in Digital DBS-TV, Master Control Station and Uplink, Installation of DBS-TV Antennas, Satellite Radio Broadcasting, Digital Video Broadcast(DVB) Standards, Digital Video Broadcast – Terrestrial (DVB-T)

Satellite Mobile Services, VSATs, Radarsat, Global Positioning Satellite System (GPS), Orbcomm, Iridium

Suggested Reading:

1. Dennis Roddy, “Satellite Communications”, 4th Edition, Tata McGraw-Hill.
2. Timothy Pratt, Charles Bostian, Jeremy Allnutt , “Satellite Communications”, 2nd Edition, John Wiley & Sons.
3. Wilbur L. Pritchard, Henri G. Suyderhoud, Robert A. Nelson, “Satellite Communication Systems Engineering” , 2nd Edition, Pearson
4. Tri T. Ha, *Digital Satellite Communication*, Tata McGraw- Hill, Special Indian Edition 2009.
5. N.Agarwal, “Design of Geosynchronous Space Craft”, Prentice Hall, 1986.

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VIII- SEMESTER
(ELECTRONICS AND COMMUNICATION ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	**PE – IV**	Professional Elective - IV	3	-	-	3	30	70	3	3
2	**PE – V**	Professional Elective - V	3	-	-	3	30	70	3	3
3	**OE - III**	Open Elective -III	3	-	-	3	30	70	3	3
4	**MC871EG**	Human Values and Professional ethics	3	-	-	3	30	70	3	0
Practicals										
5	**PC851EC**	General Seminar	-	-	2	2	25	-	-	1
6	**PC852EC**	Project Work/*Internship(Full Time)	-	-	4	4	50	100	-	8
		Total	**12**	**0**	**6**	**18**	**195**	**380**	**-**	**18**

PC: Professional Course
MC: Mandatory Course
L: Lecture
T: Tutorial
P: Practical
CIE: Continuous Internal Evaluation
SEE: Semester End Examination (Univ. Exam)

Note:

1. Each contact hour is a Clock Hour.
2. The Practical class can be of two hour (clock hours) duration as per the requirement of a particular laboratory.

***** It is mandatory for students registering for Internship (Full Time) to undertake SWAYAM/NPTEL Courses having a minimum duration of 12 weeks starting from Semester V to meet the credit requirements of Professional and Open Electives of Semester VIII.

Professional Elective - IV		
S.No.	**Course Code**	**Course Title**
1	PE871EC	Wireless Sensor Networks
2	PE872EC	Global Navigational Satellite Systems
3	PE873EC	System Verilog
4	PE874EC	Multirate Signal Processing

Professional Elective - V		
S.No.	**Course Code**	**Course Title**
1	PE875EC	Real Time Operating Systems
2	PE876EC	Fuzzy Logic And Applications
3	PE877EC	Radar Systems
4	PE878EC	Digital Fault Tolerant Systems

Open Elective - III		
S.No.	**Course Code**	**Course Title**
1	OE871EC	Fundamentals of IC Design
2	OE872EC	Wireless Communication

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core /Elective</td></tr>
<tr><td>PE871EC</td><td colspan="6">WIRELESS SENSOR NETWORKS</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>DCCN
PE672EC</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives:

- Determine network architecture, node discovery and localization, deployment strategies, fault tolerant and network security.
- Build foundation for WSN by presenting challenges of wireless networking at various protocol layers.
- Determine suitable protocols and radio hardware.
- Evaluate the performance of sensor network and identify bottlenecks.
- Evaluate concepts of security in sensor networks.

Course Outcomes:

- To understand network architecture, node discovery and localization, deployment strategies, fault tolerant and network security.
- To understand foundation for WSN by presenting challenges of wireless networking at various protocol layers.
- Study suitable protocols and radio hardware.
- To understand the performance of sensor network and identify bottlenecks.
- To understand concepts of security in sensor networks.

UNIT-I

Challenges for Wireless Sensor Networks-Characteristics requirements-required mechanisms, Difference between mobile ad-hoc and sensor networks, Applications of sensor networks- Enabling Technologies for Wireless Sensor Networks

UNIT-II

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments
Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT-III

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, Zigbee: IEEE 802.15.4 MAC Layer, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

UNIT-IV

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. Operating Systems for Wireless Sensor Networks, Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

Operating Systems for Wireless Sensor Networks, Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

UNIT-V

Security Architectures, Survey of Security protocols for Wireless sensor Networks and their Comparisions.

Suggested Reading:

1. Holger Karl and Andreas Willig, *“Protocols And Architectures for Wireless Sensor Networks,”* John Wiley, 2005.
2. Feng Zhao and Leonidas J. Guibas, *“Wireless Sensor Networks - An Information Processing Approach,”* Elsevier, 2007.
3. FazemSohraby, Daniel Minoli, and TaiebZnati, “Wireless Sensor Networks- Technology, Protocols and Applications,” John Wiley, 2007.
4. Anna Hac, “Wireless Sensor Network Designs,” John Wiley, 2003.
5. Y Wang,” A Survey of Security issues in Wireless sensor Networks”,IEEE Communications Survey and Tutorials, 2006.

Course Code	Course Title	Core / Elective

PE872EC	**GLOBAL NAVIGATIONAL SATELLITE SYSTEMS**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
DC PC601EC	3	-	-	-	30	70	3

Course Objectives:

- To understand fundamentals of Global Position System (GPS)
- To know the signal structures and error sources of GPS
- To study architectures of different GPS based augmentation systems.
- To learn the basic concepts of other GNSS constellations.
- To know the idea about Regional based navigation systems.

Course outcomes:

- Familiarize with the GNSS fundamentals and GPS architecture.
- Describe the different types of GNSS Signals and GNSS Datum.
- Analyze the GPS errors and their modeling techniques
- Understanding various GPS data processing and GPS integration techniques.
- Conceptualize the augmentation systems and regional navigation satellite systems.

Unit – I

GPS Fundamentals: GPS Constellation, Principle of operation, GPS Orbits, Orbital mechanics and satellite position determination, Time references, Geometric Dilution of Precision: GDOP, VDOP, PDOP. Solar and Sidereal day, GPS and UTC time.

Unit – II

GPS Signal Structure: GPS signals, C/A and P-Codes, GPS Signal generation, Spoofing and anti-spoofing. **Error sources in GPS:** Satellite and receiver clock errors, Ephemeris error, Atmospheric errors, Receiver measurement noise and UERE

Unit – III

GPS Augmentation systems: Classification of Augmentations Systems, Relative advantages of SBAS and GBAS, Wide area augmentation system (WAAS) architecture, Local area augmentation system (LAAS) concept, GPS Aided GEO Augmented Navigation (GAGAN), European Geostationary Navigation Overlay Service (EGNOS) and MTSAT Satellite-based Augmentation System (MSAS). Differential GPS.

Unit – IV

Other GNSSs: Architecture and features of Russian Global Navigation Satellite System (GLONASS), European Navigation System (Galileo), Chinese Global Navigation System (BieDou-2/COMPASS), GNSS Applications.

Unit – V

Regional Navigation Satellite Systems (RNSS): Indian Regional Navigation Satellite System (IRNSS), Japan's Quasi-Zenith Satellite System (QZSS), Chinese Area Positioning System (CAPS). **GPS Integration:** GPS/GIS, GPS/INS, GPS/Pseudolite, GPS/Cellular integrations.

Suggested Reading:

1. Rao G.S., "Global Navigation Satellite Systems – with Essentials of Satellite Communications", Tata McGraw Hill, 2010.
2. Sateesh Gopi, "Global Positioning System: Principles and Applications", TMH, 2005.
3. Elliot D. Kaplan, "Understanding GPS Principles and Applications", 2/e, Artech House, 2005.
4. Paul D Groves, "Principles of GNSS, Inertial, and Multi-sensor Integrated Navigation Systems" Artech House Publishers, 2017
5. Basudeb Bhatta," Global Navigation Satellite Systems: Insights into GPS, GLONASS, Galileo, Compass", B.S. Publications, 2010

Course Code	Course Title	Core / Elective

<table>
<tr><td>PE873EC</td><td colspan="6">SYSTEM VERILOG</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>DSD
PC506EC</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course objectives:

- Understand about Verification and System Verilog as tool
- Gain knowledge about using the System Verilog Tool
- Learning the concept of OOP in verification
- Using the concept of OOP classes, connections and coding
- Learn verification techniques with an example

Course Outcomes:

- Understand the evolution and importance of System Verilog
- Familiarize with the System Verilog tools
- Apply the concepts of OOP in verification
- Programming using the concepts of OOP classes, connections and coding.
- Apply verification techniques

UNIT-I

SystemVerilog as a Verification Language, Main Benefits of Using SystemVerilog, Drawbacks of Using SystemVerilog, SystemVerilog Traps and Pitfalls, The Evolution of OOP and systemVerilog, The Evolution of Functional Verification, The emergence of hardware verification languages, OOP and SystemVerilog

UNIT-II

Teal Basics: Main Components, Using Teal, simple test, Logging Output, Using Test Parameters, Accessing Memory, A memory example, Truss: A Standard Verification Framework: Overview, General Considerations, System Verilog considerations, An AHB example

UNIT-III

Overview, Sources of Complexity, Team dynamics, Creating Adaptable Code, Architectural Considerations to Maximize Adaptability. Designing with OOP: Overview, Keeping the Abstraction Level Consistent, Using “Correct by Construction”, The Value of Packages

UNIT-IV

OOP classes: overview, OOP Connections: Overview, How Tight a Connection, Types of Connections, Coding OOP: Overview, “If” Tests, Coding Tricks, Coding Idioms, Enumeration for Data, Integer for Code Interface.

UNIT-V

Overview, Theory of Operation, Verification environment, Verification IP, UART VIPs, Wishbone VIP, The verification dance, Running the UART Example, Configuration, VIP UART package, VIP UART configuration class, UART 16550 configuration class

Suggested Readings:

1. System Verilog for Design Stuart Sutherland, Simon Davidmann, Peter Flake, P. Moorby
2. Hardware Verification with SystemVerilog, An object-oriented Framework, Mike Mintz, Robert Ekendahl, Springer
3. J. Bhasker, "System Verilog Primer", B.S. Publication, 2013
4. Chris Spears, "SystemVerilog for Verification: A Guide to Learning the Testbench Language Features", 2006.
5. Ashok B Mehte, "SystemVerilog Assertions and Functional Coverage: Guide to Language, Methodology and Applications", Spinger, 2013

Course Code	Course Title	Core/Elective

PE874EC	**MULTIRATE SIGNAL PROCESSING**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
SATT PC304EC DSP PC503EC	3	-	-	-	30	70	3

Course Objectives:

- To introduce the fundamentals of Multirate signal processing and demonstrate the ability to solve problems in sample rate conversion, filter banks
- To Create efficient realizations for up sampling and down sampling of signals using the polyphase decomposition
- To develop the ability to design digital filter banks and half-band filters based on the techniques presented
- To develop the ability to design multilevel filter banks
- To Utilize MATLAB for signal analysis, digital filter design and wavelets

Course Outcomes:

- Able to solve problems in sampling rate conversion and filter banks
- Design and implement perfect reconstruction filter bank systems
- Able to implement multiphase and polyphase representation.
- Analyze the various adaptive processing algorithms
- Able to use wavelets in signal processing applications.

UNIT-I

Review of fundamentals of Multirate systems: Decimation by a integer factor D, Interpolation by a integer factor L, Time- and frequency-domain representation and analysis of decimated and interpolated signals, Efficient structures for decimation and interpolation filters, Sampling rate conversion by a rational factor I/D, Inter connection of building blocks, polyphase representation, Multi stage implementation of sampling-rate conversion, Applications of Multirate systems.

UNIT-II

Multirate Filter banks: Digital filter banks, Uniform DFT filter banks, Polyphase implementation of Uniform filter banks.

Nyquist filters: L^{th}-band filters, half band filters, Half-band High pass filter, Window Design of Half-band Filter, Interpolation and decimation with Low Pass Half-band Filters**,** Design of Linear-phase L^{th} band FIR filters, Relation between Lth-Band filters and power complementary filters.

UNIT-III

Quadrature- Mirror Filter banks: The filter bank structure, Analysis of Two channel QMF bank, Errors in the QMF bank, Alias free filter banks, Alias-free realization, Alias-free FIR QMF bank, Alias-free IIR QMF bank, perfect reconstruction(PR) two-channel FIR filter bank, Alias-free L-channel filter bank and Multilevel filter banks-filter with equal and unequal pass band widths.

UNIT-IV

Adaptive Algorithms to adjust coefficients of digital filters: Least Mean Square (LMS), Recursive Least Square (RLS) and Kalman Filter Algorithms

UNIT-V

Wavelets and its applications: Introduction to wavelet Theory, wavelet transform, Definition and properties, Continuous Wavelet Transform and Discrete Wavelet Transform, Application of Wavelets in signal processing.

Suggested Readings:

1. J.G. Proakis. D.G. Manolakis. "Digital Signal Processing: Principles. Algorithms and Applications",3rd Edn. Prentice Hall India, 1999.
2. Vidyanathan PP, "Multi-rate Systems and Filter Banks," Pearson Education, 2008.
3. B. Widrow & S Stearns: Adaptive Signal Processing, PHI, 1985
4. Bruce W Suter, "Multi-rate and Wavelet Signal Processing." Volume 8, Academic Press, 1998.
5. K. P. Soman, K. I. Ramachandran, N. G. Resmi, PHI, Insight into wavelets From theory to practice

Course Code	Course Title	Core / Elective

PE875EC	**REAL TIME OPERATING SYSTEMS**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ES PC701EC	3	-	-	-	30	70	3

Course Objectives:

- The functions performed by an Operating systems
- To differentiate between real time systems and study the scheduling algorithms
- The concepts of process synchronization
- The elementary concepts of VxWorks
- The fundamental concepts of UNIX operating system

Course Outcomes:

- Classify various types of kernels and operating systems
- Analyze various scheduling algorithms related to RTOS.
- Summarize the Inter process communication tools.
- Understand the elementary concepts of Vxworks
- Enumerate the fundamental concepts of UNIX operating system

UNIT – I

Structures of Operating System (Monolithic, Microkernel, Layered, Exo-kernel and Hybrid kernel structures), Operating system objectives and functions, Virtual Computers, Interaction of OS and Hardware architecture, Evolution of operating systems, Batch, multi programming, Multitasking, Multiuser, parallel, distributed and real-time OS.

UNIT – II

Hard versus Soft Real-Time System: Jobs and Processors, release time, deadlines, and timing constraints, hard and soft timing constraints, hard real time systems, Uniprocessor Scheduling: Types of scheduling, scheduling algorithms: FCFS, SJF, Priority, Round Robin, UNIX Multi-level feedback queue scheduling, Thread scheduling, Multiprocessor scheduling concept, Real Time scheduling concept.

UNIT – III

Concurrency: Principles of Concurrency, Mutual Exclusion H/W Support, Software approaches, Semaphores and Mutex, Message passing, Monitors, Classical problems of Synchronization: Readers-Writers problem, Producer Consumer problem, Dining Philosopher problem. Deadlock:

Principles of deadlock, Deadlock prevention, Deadlock Avoidance, Deadlock detection, An Integrated Deadlock Strategies.

UNIT – IV

Elementary Concepts of VxWorks: Multitasking, Task State Transition, Task Control – Task Creation and Activation, Task Stack, Task Names and IDs, Task Options, Task Information, Task Deletion and Deletion Safety. Memory Management – Virtual to Physical Address Mapping. Comparison of RTOS – VxWorks, μC/OS-II and RT Linux for Embedded Applications.

UNIT-V

UNIX Kernel – File System, Concepts of –Process, Concurrent Execution & Interrupts. Process Management – forks & execution. Basic level Programming with System calls, Shell programming and filters, UNIX Signals, POSIX Standards

Suggested Reading:

1. Andrew S. Tanenbaum, " Modern Operating Systems," 4/e, Pearson Edition,2014.
2. Jane W.S.Liu, "Real Time Systems," 1/e, Pearson Education, Asia, 2002.
3. Jean J Labrose,"Embedded Systems Building Blocks Complete and Ready-to-use Modules in C", 2/e, CRC Press 1999.
4. Karim Yaghmour, Jon Masters, Gilad Ben-Yesset, Philippe Gerum", Building Embedded Linux Systems, 2/e,O' Reilly Media, 2008
5. Wind River Systems, "VxWorks Programmers Guide 5.5", Wind River Systems Inc.2002

Course Code	Course Title						Core / Elective
PE876EC	**FUZZY LOGIC & APPLICATIONS**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	-	-	-	30	70	3

Course Objectives:

- The concepts of regular sets and Fuzzy sets
- To gain the knowledge of Fuzzy relations
- Different Fuzzification methods & Membership function
- Different Defuzzification methods
- Fuzzy Associative Memories, FAM system Architecture & its applications

Course Outcomes:

- To distinguish crisp sets & Fuzzy sets and perform operations on Fuzzy sets
- Define Fuzzy relations & apply operations on different Fuzzy relations
- To convert crisp sets to Fuzzy sets using different Fuzzification methods
- To convert Fuzzy sets to Crisp sets using different Defuzzification methods
- To understand Fuzzy Associative Memories & FAM system Architecture

Unit I

Basics of Fuzzy sets: Introduction to Fuzzy sets, Operation on Fuzzy sets, Properties of Fuzzy sets, Extensions of Fuzzy set concepts, Extension principle and its applications.

Unit II

Fuzzy Relations: Basics of fuzzy relations, Operations on fuzzy relations, Properties of Fuzzy relations, Fuzzy Equivalence & Fuzzy Tolerance relations, Various types of Binary fuzzy relations.

Unit III

Membership Functions: Features of the membership function, Fuzzification, Membership value assignments: Intuition, Inference, Rank ordering, Neural Networks.

Unit IV

Defuzzification, Different Defuzzification methods: Max-membership principle, Central method, weighted average method, Mean-max membership, Center of sums, Center of largest area, First (or last) of maxima.

Unit V

Fuzzy Associative Memories: FAMs as Mappings, Fuzzy Hebb FAMS, Bi-directional FAM theorem for Correlation-Minimum Encoding, Correlation-Product Encoding, Superimposing FAM rules, FAM system Architecture, Example of Invented pendulum, Basic structure and operation of Fuzzy logic control system, Applications of Fuzzy controllers.

Suggested Reading:

1. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill, 1995.
2. C.T. Lin and C.S.George Lee, "Neural Fuzzy Systems", PHI, 1996.
3. Bant A KOSKO, "Neural Nehvorks and Fuzzy Systems", PHI, 1994.
4. Altrock, C.V., "Fuzzy Logic and Neuro Fuzzy Applications explained", PHI, 1995.
5. John Harris, "Introduction to fuzzy logic applications", Springer, 2000.

Course Code	Course Title						Core / Elective
PE877EC	**RADAR SYSTEMS**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
DC PC601EC	3	-	-	-	30	70	3

Course Objectives:

- To understand RADAR system block diagram, applications and develop range equation.
- To study various parameters used to enhance range prediction such as receiver noise, noise temperature, integration of pulses etc.
- To understand the concept of CW radar and learn its variations, to study various types of displays in radar systems.
- To understand MTI radar and understand the limitations of MTI radar and non-coherent MTI radar.
- To understand radar tracking methods and study differences among them.
- To study and understand search radar and antennas.

Course Outcomes:

- Explain basics of RADAR system and will able to develop radar range equation. Illustrate the importance of various parameters in enhanced range estimation for accurate prediction
- Illustrate various types of radars such as CW radar and their variations and displays in radar
- Explain types of MTI radar and non-coherent MTI radar
- Illustrate on radar tracking methods and differences among them
- Explain search radars and various antennas used in radars

Unit I

Radar Systems: Description of basic radar system and its elements, Radar equation, Block diagram and operation of a radar, Radar frequencies, Application of Radar, Prediction of range performance, Minimum detectable signal, Receiver noise figure, Effective noise temperature, Signal to noise ratio, False alarm time and probability of false alarm, Integration of radar pulses, Radar cross-section of target, Pulse-repetition frequency and range ambiguities, System losses.

Unit II

CW and FMCW Radars: Doppler effects, CW Radar, FMCW Radar, Multiple frequency CW radar, Low noise front-ends, A-scope, B-scope, PPI Displays, Duplexers.

Unit III

MTI and Pulse Doppler Radar: MTI radar, Delay line canceller, Multiple and staggered prf, Blind speeds, Limitations to MTI performance, MTI using range gated Doppler filters, pulse Doppler radar, Non coherent radar.

Unit IV

Tracking Radar: Sequential lobing, Conical scan, Mono-pulse-amplitude comparison and phase comparison methods, Tracking in range and in Doppler, Acquisition, comparison of trackers.

Unit V

Search Radar: Range equation, search scans, Effect of surface reflection, Line of Sight (LOS), propagation effects, Environmental noise. Radar Antennas: Antenna parameters- Parabolic reflector antennas, Cassegrain antenna, Cosecant - squared Antenna pattern.

Suggested Reading:

1. Skolnik, Merrill I, Introduction to Radar Systems, 3/e, MGH, 2002.
2. Barton. David K, Modern Radar System Analysis, 1/e, Aretech House, 2004.
3. Peebles PZ, ‘Radar Principles’, John – Willey, 2004.
4. Paul A Lynn, "Radar Systemss" Springer, 1987
5. Harold Roy Reamer, "Radar Systems Principles", Springer, 1997

Course Code	Course Title						Core /Elective
PE878EC	**DESIGN OF FAULT TOLERANT SYSTEMS**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
STLD PC303EC	3	-	-	-	30	70	3

Course Objectives:

- Gain the basic concepts and metrics of reliable systems.
- To be able to comprehend the methods involved in testing of circuits.
- Appreciating the techniques involved in developing reliable and fault tolerant modules using redundancy.
- Gain insight into practical applications of reliable systems.
- Study testability, built–in-test & self-test concepts.

Course Outcomes:

- To understand the basic concepts and metrics of reliable systems.
- To understand the methods involved in testing of circuits.
- Study the techniques involved in developing reliable and fault tolerant modules using redundancy.
- Study practical applications of reliable systems.
- To understand testability, built–in-test & self-test concepts.

UNIT-I

Failures and faults, Reliability and failure rate, Relation between reliability & mean time between failure, Maintainability & Availability, reliability of series and parallel systems. Modeling of faults. Test generation for combinational logic Circuits: conventional methods-path sensitization & Boolean difference. Random testing- transition count testing and signature analysis.

UNIT-II

Basic concepts ,static,(NMR and use of error correcting codes), dynamic, hybrid and self-purging redundancy, Sift-out Modular Redundancy (SMR), triple modular redundancy, SMR reconfiguration.3

UNIT-III

Time redundancy, software redundancy, fail-soft operation, examples of practical fault tolerant systems, introduction to fault tolerant design of VLSI chips.

UNIT-IV

Design of totally self-checking checkers, checkers using m-out of a codes, Berger codes and low cost residue code, self-checking sequential machines, partially self-checking circuits. Fail safe Design: Strongly fault secure circuits, fail-safe design of sequential circuits using partition theory and Berger codes, totally self-checking PLA design.

UNIT-V

Basic concepts of testability, controllability and observability. The Reed-Muller expansion technique, level OR-AND-OR design, use of control and syndrome-testing design.
Built-in-test, built-in-test of VLSI chips, design for autonomous self-test, design in testability into logic boards.

Suggested Reading:

1. Parag K. Lala, “Fault Tolerant & Fault Testable Hardware Design”*,*PHI, 1985
2. Parag K. Lala, “Digital systems Design using PLD’s”*,* PHI 1990.
3. N.N. Biswas, “Logic Design Theory”, PHI 1990.
4. Konad Chakraborthy & Pinaki Mazumdar, Fault tolerance and Reliability Techniques for high – density random – access memories Reason*,* 2002.
5. Rolf Isermann “Fault Diagnosis Applications”, Springer 2011.

<table>
<tr><td>Course Code</td><td colspan="4">Course Title</td><td colspan="2"></td><td>Core /Elective</td></tr>
<tr><td>PC851EC</td><td colspan="6">GENERAL SEMINAR</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Nil</td><td>3</td><td>-</td><td>-</td><td>-</td><td>25</td><td>-</td><td>2</td></tr>
</table>

Course Objectives:

- To expose students to the 'real' working environment
- To promote and develop presentation skills
- To set the stage for future recruitment by potential employers

Course Outcomes:

- Demonstrate an appreciation of contemporary development issues and methodologies in Electronics and Communication Engineering through a well-structured technical report writing conforming to International Standards.
- Demonstrate an awareness of current trends in specific areas of interest.
- Deliver a polished presentation demonstrating transferable skills and good practices for presentation of technical material.

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of state of the art topics in road area of his/her specialization.

Seminar topics may be chosen by the students with the advice from faculty members. Students are to be exposed to following aspects of seminar presentations.

- Literature survey
- Organization of material
- Preparation of OHP slides/PC presentation
- Technical writing

Each student is required to

1. Submit a one page synopsis of the seminar talk for display on notice board.
2. Give a 20 minutes presentation through OHP, PC, slide projector, followed by 10mts discussion.
3. Submit a report on the seminar topic with list of references and slides used Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule should be discouraged.

The sessional marks will be awarded to the student by at least 2 faculty members on basis of an oral and a written presentation as well as their involvement in the discussions.

Course Code	Course Title						Core /Elective
PC852EC	**PROJECT WORK**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Nil	-	-	-	4	50	100	8

Course Objectives:

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic Literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes:

- demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
- evaluate different solutions based on economic and technical feasibility
- effectively plan a project and confidently perform all aspects of project management
- Demonstrate effective written and oral communication skills

The aim of project work is to implement and evaluate the proposal made as part of project - I . Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction. The department will appoint a project coordinator who will coordinate.

All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for 25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction. Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: Three periods of contact load will be assigned to each project guide.

FACULTY OF ENGINEERING

Scheme of Instruction & Examination

(CBCS Curriculum for the Academic Year 2019-2020)

and

Syllabi

B.E. VII and VIII Semester

of

Four Year Degree Programme

In

Mechanical Engineering

(With effect from the academic year 2019– 2020)
(As approved in the faculty meeting held on 25-06-2019)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad – 500 007

2019

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VII - Semester
(MECHANICAL ENGINEERING)

S.No	Course Code	Course Title	Scheme of Instruction			Contac Hr/Wk	Scheme of Examination			Credits
			L	T	P/D		CIE	SEE	Duration in Hours	
Theory Courses										
1.	PC 701 ME	Thermal Turbo Machines	3	1	-	4	30	70	3	4
2.	PC 702 ME	Finite Element Analysis	3	1	-	4	30	70	3	4
3.	PC 703 ME	Industrial Engineering	3	-	-	3	30	70	3	3
4	PC 704 ME	Production And Operations Management	3	-	-	3	30	70	3	3
5	HS CM	Managerial Economics and Accountancy	3	-	-	3	30	70	3	3
6	OE-II	Open Elective-II	3	-	-	3	30	70	3	3
Practical / Laboratory Courses										
7	PC 751 ME	Thermal Engineering			2	2	25	50	2	1
8	PC 752 ME	CAE Lab			2	2	25	50	2	1
9	PC 753 ME	Project Seminar			4	4	50	-	-	2
10	PW 961 CS	Summer Internship	-	-	-	-	50	--		2
Total			18	2	8	28	330	520		26

Open Elective - II

S.No	Course Code	Course Ttile
	PE 824 ME	Entrepreneurship **
		Mechatronics **

PC: Professional Course **PE**: Professional Elective **OE**: Open Elective **MC**: Mandatory
L: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note -1:

1. Each contact hour is a Clock Hour
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment

Note-2:

* The students have to undergo a Summer Internship of two weeks duration after IV semester and credits will be awarded in VII semester after evaluation.
****** Subject is not offered to the students of Mechanical, Production and Automobile Engineering Department

Course Code	Course Title						Core/Elective
PC701ME	THERMAL TURBO MACHINES						Core
Thermal Engg.	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	3

Course Objectives:

Course Outcome:

- Analyze situations of Thermal gradients in Turbo machines and apply the situation of fluid flow analysis with energy conversion principles for work transfer.
- Develop knowledge about working principles of work absorption and work producing situations
- Understand applications of Thermodynamics with fluid flow behavior and compressibility effects
- Attain knowledge of Power production using External combustion engines, with methods of improving efficiencies
- Demonstrate the learnt fundamentals in applying for real time situations such as undertaking final dissertation projects on Thermal turbo Machines and power plants with knowledge of International standards and testing.
- Establish and compute one dimensional thermodynamic analysis of Compressors, Turbines (both for air & Vapour working fluids) and analyzing using velocity triangles for single and multi stages.

UNIT-1

Introduction to compressible flows: Speed of propagation of pressure waves, Mach number, Acoustic velocity and Mach cone, limits of compressibility, pressure field due to a moving source of disturbance, one dimensional compressible flow.

Isentropic flow with variable area, Mach number variation, Area ratio as function of Mach number, flow through nozzles and diffusers.

Flow in constant area ducts with friction-Fanno flow, variation of flow properties, variation of Mach number with duct length, isothermal flow with friction

UNIT-II

Flow in constant area duct with Heat Transfer, -The Rayleigh liner, Rayleigh flow relations, variation of flow properties, Maximum heat transfer.

Flow with Shock Waves-Development of Normal Shock waves, governing equations, Prandtl -Meyer relation, Rankine-Hugoniot equations, Stagnation pressure ratio across shock.

UNIT-III

Blade nomenclature of an aerofoil, Rotodynamic compressors: Introduction and general classification, Comparison of Reciprocating and Rotary compressors, Positive displacement Rotary compressors, Flow through rotary compressors. Static and total head quantities, Thermodynamic cycles and work done,calculation of various efficiencies. Velocity diagrams and prewhirl. Euler equation for energy transfer between fluid and rotor, Analysis of Centrifugal compressors and analysis of axial flow compressors, Chocking, Surging and Stalling.

UNIT-IV

Steam Turbines: Classification, flow over blades, pressure velocity variations, Compounding of steam turbines- pressure compounding, velocity compounding and pressure-velocity compounding, Impulse turbine with several blade rings, Nozzle efficiency, Blade efficiency and Gross stageefficiency of Impulse turbine, Velocity diagrams for Impulse turbine-De Laval Turbine, blade efficiency of Impulse turbine, Optimum blade speed ratio, Maximum work done and blade efficiency of Impulse turbine, Degree of reaction of Reaction turbine, Parson Reaction turbine, Velocity diagram for Parson Reaction turbine, blade efficiency of Parson Reaction turbine, Maximum work done and blade efficiency of Parson Reaction turbine, Height of blades of Reaction turbine, Balancing of End thrust.

UNIT-V

Gas Turbines: Applications and Classification of Gas Turbines- constant pressure and constant volume gas turbines, Joule cycle-configuration diagram and temp-entropy diagram, Thermal efficiency of Joules cycle, Maximum pressure ratio in terms of temperature ratio, optimum pressure ratio for maximum work output with and without considering machine efficiencies, Improvement of gas turbine plant performance- Inter-cooling, Reheating and Regeneration. Simple Problems on Joule cycle.

Air Craft Propulsion: Air craft engine types, air craft propulsion theory, Turbo jet engines, Ramjet engines, Pulse jet engines, Rocket Propulsion: Types of Propellants, Types of Rocket engines, Rocket propulsion theory-Rocket applications.

Suggested Reading:

1.Yahya S M, *Fundamentals of Compressible Flow,* New Age International Publishers, Third Edition, 2007.
2.Mathur ML, & Mehta F S, *Thermal Engineering,* Jain Brothers, New Delhi, 2003.
3.Dennis G Shepherd, *Aerospace Propulsion,* Elsevier Publishing Company, New York, 1995.4.Cohen H Rogers G F C, SaravanaMutto H I H, *Gas Turbine Theory,* Longman 5th Edition, New York, 2004.
5.Ganeshan V, *Gas Turbines,* Tata Me Graw Hills, New Delhi, 2003
6.Yadav, R *Steam and Gas Turbines,* Central Publishing House Ltd, Alllahabad, 2003.

Course Code	Course Title						Core/Elective
PC702ME	FINITE ELEMENT ANALYSIS						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
EM, MOM, FM, HT	3	1	-	-	30	70	3

Course Objectives:

Course Outcome:

- Summarize basic equations of elasticity and formulate finite element modeling of one dimensional element using Potential energy approach.
- Formulate finite element modeling of truss and frame elements along with the concepts of transformation from local to global matrices.
- Interpolate Hermitian shape function of beam element in natural coordinate system.
- Develop stiffness matrix for a plane stress & plane strain conditions on a CST, Axisymmetric elements by interpolating shape functions in natural coordinate system.
- Interpolate the shape functions of Isoparametric elements and to present the use of numerical integration to evaluate the element matrices in typical 2D problems. Formulate finite element model to steady state heat transfer analysis using one & two dimensional elements.
- Formulate mass and stiffness matrices of 1D & beam elements to establish Eigen values &Eigen vectors using Lagarangian and Hamilton principles. Develop finite element model for 3D problems in stress analysis and explain the concepts of convergence criteria.

UNIT-I

Introduction to Finite Element Method for solving field problems, Stress and Equilibrium, Boundary conditions, Strain, Displacement, Stress-Strain relations.

One dimensional problems:

Finite element modeling coordinates and shapes functions, Potential Energy approach: Assembly of Global stiffness matrix and load vector, Finite element equations, Treatment of boundary conditions, Galerkin's approach, Quadratic shape functions.

UNIT-II

Analysis of trusses and frames: Element stiffness matrix for a truss member, Analysis of plane truss with 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 nodes (two degrees of freedom per node).

UNIT-III

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

UNIT-IV

Two dimensional four nodediso-parametric elements and numerical integration. Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional analysis of thin plate, Analysis of circular shaft subjected to torsion.

UNIT-V

Dynamic Analysis: Formulation of finite element model, 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. Introduction to finite element formulation of three dimensional problems in stress analysis, Convergence requirements. Introduction to Finite Element Analysis Software.

Suggested Reading:

1. G.Ramamurthy, Applied Finite Element Analysis, I.K. International Publishing House Pvt.Ltd., New Delhi, 2009.
2. Tirupathi R, Chandraputla and Ashok D Belagundu, Introduction to Finite Elements in Engineering ,Prcatice Hall of India,1997.
3. Rao S S, The Finite Element Method in Engineering, Pergamon Press, 1989.
4. Segerlind L J, Applied Finite Element Analysis, Wiley Eastern, 1984.
5. Reddy JN, An Introduction to Finite Element Method, McGraw-Hill, 1984.

Course Code	Course Title						Core/Elective
PC703ME	INDUSTRIAL ENGINEERING						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives:

- To learn the concept of Management.
- To understand role of Production Planning and Control in Industry.
- To learn various material procurement policies.
- To understand importance of quality control and various methods.
- To interpret the role of Decision theory in Industry.

Course Outcomes:

- Explain various approaches for industrial management. Able to infer concept of management in human resource domain
- Apply Philosophy of Production Planning and Control in Industry and control the activities in delivering the products in time
- Determine the optimum requirement of inventory by developing the various quantitative models.
- Develop various models or methods for ensuring the required quality of the products or processes.
- Elaborate the role of Decision theory and apply various approaches under Uncertainty and Risk conditions

UNIT-I

Management: Introduction to Management, Scientific Management, Systems approach to Management, MBO, and Decision Making Process.

Personnel Management: Functions of personnel management, types of training, Job evaluation and Merit rating, Collective bargaining and labour participation in management.

UNIT-II

Production Planning & Control: Definition, Objectives, Importance and Functions of Production Planning & Control.

Production Control: Routing, Scheduling, Dispatching, Follow-up and progress Report.

UNIT-III

Inventory Control: Importance of inventory control, types of inventory models Inventory costs deterministic inventory models Basic EOQ models, production model without shortages, Purchase model with instantaneous replenishment and with shortages production model with shortages Inventory model with price breaks, Fixed order quality system, periodic review system Inventory model with probabilistic demand

UNIT-IV

Quality Control : Concept of quality, evolution of quality control, assignable and chance causes of variation, Variable Control charts ($\bar{X}$ and R charts) ,

Attributes control charts: P chart and C chart

Acceptance Sampling – Single Sampling, Double Sampling and Multi sampling plans – OC curves of single sampling plans

UNIT-V

Decision Theory : Introduction, Decision, Decision Making & Decision Theory, Types of Decisions, decision making process, Types of Decision making Environment:

Decision making under Uncertainty- Criterion of Optimism or Maximax, Criterion of Pessimism or Maximin, Minimax decision criteria

Decision making under Risk –Expected Monetary Value(EMV), Expected Opportunity Loss (EOL) Criterion & Expected Value of Perfect Information(EVPI) Criterion
Decision Trees

Suggested Reading:

1. M.Mahajan, *"Industrial Engineering and Production Management"*, Dhanpatrai& sons, New Delhi
2. S.K.Sharma and Savitasarma, *"Industrial Engineering and Organization Management"*, SK Kataria& Sons, New Delhi.
3. S.D. Sharma, "*Operations Research*", Kedarnnath, Ramnath& Co., Meerut, 2009
4. S Kalavathi, "*Operations Research"*, Vikas Publishing House Pvt. Ltd, 2009
5. V. K. Kapoor , "*Operations Research"*, S. Chand, New Delhi.
6. SK Sharma &Savita Sharma," A course in Industrial Engineering & Operations Management", S K Kataria& Sons, 2008.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core/Elective</th></tr>
<tr><td>PC704ME</td><td colspan="6">PRODUCTION AND OPERATIONS MANAGEMENT</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours Per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>-</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives:

- To understand the concept of Production & Operations Management.
- To understand role of work study and work measurement in Industry.
- To learn use of forecasting and various methods of it.
- To understand importance Aggregate planning, Materials Requirement Planning for Industry.
- To understand Project Management approaches in completion of Project.

Course Outcomes:

- Explain various types of Production Systems, develop suitable layout for a given plant
- Develop various methods for work study and apply suitable Recording techniques. Develop standard procedures and time for the operations.
- Explain necessity of Forecasting and various methods of it. Develop suitable quantitative forecasting technique for the given past data. Compare accuracy of models in connection with forecast errors.
- Explain Aggregate planning & Mater scheduling, Materials Requirement Planning Processes. Develop quantitative models for Material requirement and resources based on time span.
- Elaborate the usages of PERT/CPM techniques for a give project and develop suitable quantitative model for the project in successful competition by identifying the time constraints for start and end of process activities.

UNIT-I

Production & Operations Management: Introduction, Types of production Systems. Job shop, Batch, Flow shop.

Plant location and layout: Factors affecting plant location, Break even analysis, plant layout objectives, Types of layouts, merits and demerits.

UNIT-II

Work Study: Introduction to method study, Steps in method study, Recording techniques- Flow process chart, String diagram, Therbligs, Principles of motion economy.

Work measurement: Stop watch time study, Standard time calculation. Work sampling- procedure, applications, advantages and disadvantages, Wages and incentives, types of incentive plans.

UNIT-III

Forecasting: Introduction, Forecasting objectives and uses, demand patterns, Qualitative models Market survey, Delphi Tech, Quantitative models, Moving average, Weighted moving average, Simple exponential smoothing, trend adjusted exponential smoothing, Least square method, Simple regression, multiple regression.

Forecast errors: Mean absolute Deviation (MAD), Mean Square Error (MSE), Mean Forecast Error(MFE), Mean absolute percentage error (MAPE).

UNIT-IV

Aggregate Planning and Master Scheduling: Introduction, objectives of aggregate planning, Cost in aggregate planning, Strategies in aggregate planning, Master production scheduling.

Materials Requirement Planning MRP 1: Importance of MRP, MRP system inputs and outputs, MRP calculations

Manufacturing Resource Planning MRP 2 & Enterprise Resource Planning (ERP): Features of ERP packages like SAP,BANN, People soft etc.,

UNIT-V

Project Management: Project management: Network fundamentals, difference between PERT/CPM Scheduling the activities. Fulkerson's rule. Earliest and latest times. Determination of ES and EF in the forward path. LS and LF in backward path. Determination of critical path. Free float, independent float, Total float, Program evaluation and review technique, crashing of network.

Suggested Readings:

1. Joseph Monk, *Operations Management*, TMH Publishers, New Delhi, 2004.
2. Buffa Elwood S, *Modern Production / Operations Management,* John Wiley Publishers, Singapore, 2002.
3. Everett E Adam, Jr and Ronald J. Ebert, *Production and Operations Management – Concepts, Models and Behaviour,* 5th Ed. 1998, (EEE), Prentice Hall of India(P) Ltd., New Delhi.
4. PanneerSelvam R, "*Operations Research*", Second Edition, PHI Learning Pvt. Ltd. New Delhi, 2006.
5. S.D. Sharma, "*Operations Research*", Kedarnnath, Ramnath& Co., Meerut, 2009.

Course Code	Course Title						Core/Elective
	MANAGERIAL ECONOMICS AND ACCOUNTANCY						**Core**
Prerequisite	**Contact Hours Per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
-	3	-	-	-	30	70	3

Course Objectives:

- To understand responsibilities of a manager of a business undertaking.
- To analyze various factors influencing demand elasticity
- To Forecast & compute the future sales level.
- To determine Break Even Point (BEP) of an enterprise
- To understand the features, steps, merits, uses & limitations of Pay Back, ARR, NPV, PI & IRR methods of Capital Budgeting
- To understand the principles of accounting and prepare Journal, Ledger, Trial Balance, Manufacturing A/c, Trading A/c., Profit & Loss A/c. and Balance Sheet of an enterprise.

Course Outcomes:

- Determine the responsibilities of a manager of a business undertaking.
- Assess various factors influencing demand elasticity
- Able to Forecast & compute the future sales level.
- Determine Break Even Point (BEP) of an enterprise Outline the features, steps, merits, uses & limitations of Pay Back, ARR, NPV, PI & IRR methods of Capital Budgeting
- Understands the principles of accounting and prepare Journal, Ledger, Trial Balance, Manufacturing A/c, Trading A/c., Profit & Loss A/c. and Balance Sheet of an enterprise.

UNIT-I
Introduction to economics and its evolution: Managerial Economics its Scope, Importance and relation to other sciences, its usefulness to engineers-Basic concepts of Managerial Economics.

UNIT-II
Demands: Analysis-concept of demand, determinants, law of demand, its assumptions, elasticity of demand, price, income and cross elasticity, demand forecasting-markets competitive structure, price- output determination under perfect competition and Monopoly.

UNIT-III
Theory of Production: Firm and industry-production function-input-output relations-laws of returns- internal and external economics of scale. Cost analysis-Cost concepts-fixed and variable costs-explicitly and implicitly costs-out pocket of costs and imputed costs-opportunity cost-cost output relation- ship-break even analysis.

UNIT-IV
Capital management: Significance, determinates and estimation of fixed and working capital requirements, sources of capital. Introduction to capital budgeting, methods of payback and discounted cash flow methods with problems.

UNIT-V
Book-keeping: Principles and significance of double entry book keeping, journal, subsidiary books, ledger accounts, trial balance concepts and preparation of final accounts with simple adjustments- analysis and interpretation of financial statements through ratios.

Suggested Readings:

1. Varshney RL and KI Maheswari, Managerial Economics, Sultan Chand.
2. JC Pappas and EF Grigham, Managerial Economics.
3. Grawal T.S. Introduction to Accountancv.
4. Maheswari S.N. Introduction to Accountancy.
5. Panday I.M. Financial Management.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core/Elective</th></tr>
<tr><td>PE 824 ME</td><td colspan="6">ENTREPRENEURSHIP</td><td>Elective</td></tr>
<tr><th rowspan="2">Prerequisite</th><th colspan="4">Contact Hours Per Week</th><th rowspan="2">CIE</th><th rowspan="2">SEE</th><th rowspan="2">Credits</th></tr>
<tr><th>L</th><th>T</th><th>D</th><th>P</th></tr>
<tr><td>-</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives:

Course Outcomes:

- Understand Indian IndustriaI Environment, Entrepreneurship and Economic growth, Small and Large scale Industries, Types and forms of enterprises.
- Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
- Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
- Apply the concepts of Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques
- Understand the Behavioral aspects of entrepreneurs, Time Management, Various approaches of time management, their strengths and weakness. The urgency addiction and time management matrix.

UNIT-I

Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.

UNIT-II

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

UNIT-III

Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis, project financing in India.

UNIT-IV

Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of tax burden.

UNIT-V

Behavioural aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

Suggested Readings:

1.Vasant Desai, *"Dynamics of Entrepreneurial Development andManagement",* Himalaya Publishing House, 1997.

2.Prasanna Chandra, *"Project-Planning, Analysis, Selection,Implementation and Review",* Tata Mcgraw-Hill Publishing CompanyLtd. 1995.

3.Stephen R. Covey and A. Roger Merrill, *"First Things First",* Simon and Schuster Publication, 1994.
4.G.S. Sudha, *"Organizational Behaviuor",* 1996.
5.Robert D. Hisrich, Michael P. Peters, *"Entrepreneurship",* Tata Me Graw Hill Publishing Company Ltd., 5^{lh} Ed., 2005.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core/Elective</th></tr>
<tr><td>PC 751 ME</td><td colspan="6">THERMAL ENGINEERING LABORATORY</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours Per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>2</td><td>25</td><td>50</td><td>1</td></tr>
</table>

Course Objectives:

Course Outcomes:

- Interpret the link between refrigeration effects, work done and COP of the system, describe different methods adopted to evaluate COP,list the different psychrometric processes and describe how those processes can be maintained
- Calculate the overall efficiency of centrifugal blower and axial flow fan at different volume flow rates, show the variation of overall efficiency with load and speed graphically
- Identify the various components of low speed wind tunnel, plot a graph showing variation of pressure over the entire length of aerofoil blade and also evaluate the lift and drag coefficient values for a given aerofoil blade at different angle of assign
- Describe the modes of heat transfer, calculate thermal conductivity, heat transfer coefficient subjected to natural and forced convection environment and Stefan Boltzmann constant value of thermal radiation
- Express the working principle of heat exchangers and its application in real life, calculate the LMTD and effectiveness of a given heat exchanger for both parallel and counter flows

1. Determination of COP of the Air conditioning system
2. Determination of percentage relative humidity and study of humidification and dehumidification process in Air Conditioning systems
3. Determination of COP of refrigeration systems using capillary tube/ thermostatic expansion valve
4. Determination of overall efficiency of centrifugal blower
5. Determination of overall efficiency of axial flow fan
6. Pressure distribution on symmetrical and non-symmetrical specimen in wind tunnel
7. Measurement of lift and drag force of the models in wind tunnel test section
8. Determination of thermal conductivity of metal bar
9. Determination of the efficiency of pin-fin subjected to natural and forced convection
10. Determination of effectiveness of parallel flow and counter flow heat exchanger
11. Determination of emissivity of given test plate
12. Determination of Stefan Boltzmann constant

Course Code	Course Title						Core/Elective
PC 752 ME	CAE LAB						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1

Course Objectives:

1. To introduce fundamentals of the analysis software, its features and applications.
2. To learn the basic element types in Finite Element analysis.
3. To know the concept of discretization of continuum, Loading conditions and analyse the structure using pre-processor and postprocessor conditions.

Course Outcomes:

- Classify the types of Trusses (Plane Truss & Spatial Truss) and Beams (2D & 3D) with various cross sections to determine Stress, Strains and deflections under static, thermal and combined loading
- Generalize Plane stress, plane strain conditions & axisymmetric loading on inplane members to predicting the failure behavior and finding the SCF
- Analyse connecting rod with tetrahedron and brick elements, performing static analysis on flat & curved shells to determine stresses, strains with different boundary conditions.
- Predict the natural frequencies and modes shapes using Modal, Harmonic analysis. Also finding the critical load using Buckling analysis
- Simulate steady state heat transfer analysis of chimney, Transient heat transfer of castings, Non-linear, Buckling analysis of shells &CFD analysis
- Evaluate the stiffness matrix , B matrix and loading matrices of beam/in plane/solid elements using MATLAB software

1. Analysis of Plane Truss & Spatial Truss with various cross sections and materials to determine member forces, member strains & stresses, joint deflections under static , thermal and combined loading
2. 2D & 3D beam analysis with different sections, different materials for different loads (forces and moments) with different end supports
3. Static analysis of plate with a hole to determine the deformations, the Stresses to study the failure behavior and SCF.
4. Plane stress, plane strain and axisymmetric loading on the in plane members with in plane loading to study the stresses and strains.
5. Static analysis of connecting rod with tetrahedron and brick elements
6. Static Analysis of flat and curved shell due to internal pressure and moments to estimate the strains, stresses and reactions forces and moments with different boundary conditions
7. Buckling analysis of plates, shells and beams to estimate BF and modes
8. Modal analysis of beams, plates and shells for natural frequencies and mode shapes
9. Harmonic analysis of a Shaft subjected to periodic force and transient analysis of plate subjected to stepped and ramped loading with varying time
10. Steady state heat transfer Analysis Cross section of chimney and transient heat transfer analysis of solidification of castings.
11. Non linear analysis of cantilever beam with non-linear materials at tip moment and post Buckling analysis of shells for critical loads
12. Coupled field analysis.
13. Flow analysis of pipe with different fluids/gasses/air for velocity and pressure gradients
14. CFD analysis of aerofoil design
15. CFD analysis of ducts/impeller/fan
16. Use of MATLAB for finding B matrix, stiffness matrix and loading matrices of beam/in plane/solid elements and interfacing with CAE software's

Note: 1. Any of FEA software ANSYS/ABAQUS/NASTRAN/NISA/CAEFEM/ADINA may be used
2. Any 12 experiments to be conducted

Course Code	Course Title						Core/Elective
PC 753 ME	INTERNSHIP SEMINAR						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	-	-

Course Objectives:

- Produce an accurate record of work performed during the Internship/Co-op
- Apply engineering knowledge to a problem in industry
- Produce a technical report
- Discuss work in a team environment, if relevant to the project
- Conduct herself/himself responsibly, safely, and ethically in a professional environment

Students should carefully discuss with their industry mentor the time expectations for completion of the requirements of the class, and these expectations should be clearly articulated in the Engineering Internship/Co-op Form. Typical total time on an internship/co-op is full-time at 40 hrs/week and is typically paid.

The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship/co-op

- Overview of company/project
- Safety training
- Discussions with project teams
- Background research, review of documents, white papers, and scientific papers
- Planning, designing, and reviewing the planned work
- Executing the plans
- Documenting progress, experiments, and other technical documentation
- Further team discussions to discuss results
- Final report writing and presentation

Each student will be required to

1. Submit a one page synopsis of the seminar to be delivered 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.

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

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VIII - Semester
(MECHANICAL ENGINEERING

S.No	Course Code	Course Title	Scheme of Instruction			Contact Hr/Wk	Scheme of Examination			Credits
			L	T	P/D		CIE	SEE	Duration in Hours	
Theory Courses										
1.	PE – II	Professional Elective-II	3	-	-	3	30	70	3	3
2.	PE – III	Professional Elective-III	3	-	-	3	30	70	3	3
3.	PE – IV	Professional Elective-IV	3	-	-	3	30	70	3	3
Practical / Laboratory Courses										
5	PC 851 ME	Seminar			2	2	25	50	2	1
6	PC 852 ME	Project			8	8	25	50	2	4
Total			9	-	10	19	140	310		14

Professional Elective - II

1.	PE821 ME	Design of Solar Energy System	3	-	-	3	30	70	3	3
2.	PE822 ME	Mechanical Vibrations	3	-	-	3	30	70	3	3
3.	PE823 ME	Composite Materials	3	-	-	3	30	70	3	3
4.	PE 824 ME	Non-Destructive Testing	3	-	-	3	30	70	3	3

Professional Elective - III

1.	PE 831 ME	Power Plant Engineering	3	-	-	3	30	70	3	3
2.	PE 832 ME	Robotic Engineering	3	-	-	3	30	70	3	3
3.	PE 833 ME	Tool Design	3	-	-	3	30	70	3	3
4.	PE 834 ME	Product Design And Process Planning	3	-	-	3	30	70	3	3

PC: Professional Course **PE**: Professional Elective **OE**: Open Elective **MC**: Mandatory
L: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note -1:

1. Each contact hour is a Clock Hour
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment

Note-2:

* The students have to undergo a Summer Internship of two weeks duration after IV semester and credits will be awarded in VII semester after evaluation.

** Subject is not offered to the students of Mechanical, Production and Automobile Engineering Department

Course Code	Course Title						Core/Elective
PE 821 ME	DESIGN OF SOLAR ENERGY SYSTEM						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives: Student will understand
- Understand the design concepts of solar systems.
- Design and development of solar thermal systems.
- Design of photovoltaic system and its components.
- Analyze the performance of solar energy systems.

Course Outcomes: After completing this course, students will be able to:
- Analyze the design concepts of solar systems.
- Apply the design concepts of solar systems.
- Understand various solar components
- Design and select various solar components
- Evaluate the performance solar system

UNIT-I

System conceptual design, design of major components, overall system, design of physical principles to the solar system based on application. The process includes idea generation, concepts selection and estimation, design of major components, and overall system design, solar radiation data.

UNIT-II

Design of solar thermal systems for water, space heating, cooling and power generation. f-Chart calculation method for sizing solar water and space heating systems. Design of non-focusing and focusing collectors.

UNIT-III

Design aspects of solar thermal energy storage systems. Selection criteria of storage materials for heating and cooling applications, selection of heat transfer fluid for heating and cooling applications. Design of LHTES for solar process heating and power generation applications.

UNIT-IV

Design of photovoltaic off-grid and grid- connected power systems. Design of system components - PV modules, batteries, charge controllers, inverters, auxiliaries. Performance analysis of a photovoltaic system. Using software codes for design of solar thermal and photovoltaic systems.

UNIT-V

Performance analysis of various solar thermal systems, PV system and evaluation of solar thermal energy storage system, selection of components and materials, estimation of economics. Using software tools for design of solar thermal and photovoltaic systems, case studies.

Suggested Readings:

1.Duffie .J.A and Beckman .W.A, “Solar Engineering of Thermal Process”, Wiley,3rd ed., 2006.
2.Da Rosa .A.V, “Fundamentals of Renewable Energy Processes”, 2nd ed., Academic Press, 2009.
3.Kalogirou .S.A, “Solar Energy Engineering: Processes and Systems”, Academic Press, 2009.
4.Sen .Z, “Solar Energy Fundamentals and Modeling Techniques”, Turkey, 2008.
5.Vogel .W, Kalb .H, “Large- Scale Solar Thermal Power Technologies”, Wiley-VCH, 2010.
6.Dincer .I, Rosen .M, “Thermal Energy Storage”, 2nd ed., Wiley, 2011.
7.Prasad .D, &Snow .M, “Designing with Solar Power”, Earthscan, 2005

Course Code	Course Title						Core/Elective
PE 822 ME	MECHANICAL VIBRATIONS						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives: Student has to understand the
- Explain the concept of vibrations, with single and multi-degree freedom
- Discuss the numerical methods involved in vibrations
- Demonstrate the concept of Transient vibrations and Random vibrations
- Identify various methods of vibration control.
- Describe the concept of Non-Linear vibrations Identify various methods of vibration control.

Course Outcomes: At the end of the course, the students will be able to
- analyse the multi degree of freedom systems vibrations
- formulate vibration problem using various numerical methods
- interpret the concept of the Random and Transient vibrations
- apply various methods for vibration control
- interpret the non-linear phenomenon of vibrations and their formulation

UNIT-I

Multi Degree Freedom System:-Free Vibration equation of motion. Influence Coefficient i)StiffnessCoeff. (ii) Flexibility Coeff. Generalized co ordinates, and Coordinate couplings. Langranges Equations Matrix Method Eigen Values Eigen Vector problems. Modal Analysis. Forced Vibrations of undamped system and modal analysis. Multi Degree System Numerical Methods:-(i)Rayleigh`s Method, (ii)Rayleigh-Ritz Method (iii)Holzer`s Method (iv)Methods of Matrix iterations (v) Transfer Matrix Method, Impulse response and frequency response functions.

UNIT-II

Continuous System:- Vibrations of String, Bars, Shafts and beams, free and forced vibration of continuous systems.

UNIT-III

Modal Parameter Extraction Methods Introduction – Preliminary checks of FRF Data – SDOF Modal Analysis-I – Peak-amplitude – SDOF Modal Analysis-II – Circle Fit Method – SDOF Modal Analysis III – Inverse Method – Residuals – MDOF curve-fitting procedures – MDOF curve fitting in the Time Domain – Global or Multi-Curve fitting – Non linear systems.

Unit-IV

Vibration Control:-Balancing of rotating machine, In-situ balancing of rotors, control of natural frequency introduction of damping, vibration isolation & vibration absorbers..Vibration Measurement:- FFT analyzer, vibration exciters, signal analysis. Time domain & Frequency domain analysis of signals. Experimental modal analysis, Machine Conditioning and Monitoring, fault diagnosis.

Unit-V

Random Vibrations:- Expected values auto and cross correlation function, Spectral density, response of linear systems, analysis of narrow band systems. Non Linear Vibrations:-Systems with non-linear elastic properties, free vibrations of system with non-linear elasticity and damping, phase-plane technique, Duffing’s equation, jump phenomenon, Limit cycle, perturbation method.

Suggested Readings:

1. W T Thomson., “ Theory of Vibrations with Applications”, CBS Publishers
2. S S Rao, “ Mechanical Vibrations”, Addison-Wesley Publishing Co.

3. Leonard Meirovitch, “ Fundamentals of Vibration”, McGraw Hill International Edison.
4. J P Den Hartog, “Mechanical Vibrations”, McGraw Hill.
5. Srinivasan, “ Mechanical Vibration Analysis”, McGraw Hill.
6. Nuno Manuel Mendes Maia et al,” Theoretical and Experimental Modal Analysis”, Wiley John & sons, 1999

Course Code	Course Title						Core/Elective
PE 823 ME	COMPOSITE MATERIALS						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives: The objectives of this course are to:
- Discuss the basic structure of composites
- Define Elastic constants and Hygro-thermal stresses
- identify stress-strain relations in composites
- Describe the behaviour and Design with composites
- Demonstrate the basic equations of plate bending

Course Outcomes: On completion of the course the student will be able to:
- demonstrate knowledge of composites and their structure
- predict the Elastic constants and Hygrothermal stresses
- analyse the stress - strain relationship in composites
- summarise and apply the Design procedure and the failure criteria.
- formulatePlate bending equations for various Boundary conditions of composite plates.

UNIT-I

Introduction: Fibres, Matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composite, carbon fibre composites.

UNIT-II

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

UNIT-III

Macro-mechanics 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, inter-laminar stresses and edge effects. Simplified composite beam solutions. Bending of laminated beams.

UNIT-IV

Strength, fracture, fatigue and design:
Tensile and compressive strength of unidirectional fibre composites, fracture modes in composites: Single and multiple fracture, de-bonding, fibre pullout and de-lamination failure, fatigue of liminate composites, Effect of variability of fibre strength.
Strength of an orthotropic lamina: Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria. Designing with composite materials.

UNIT-V

Analysis of plates and stress:
Plate equilibrium equations, Bending of composite plates, Levy and Navier solution for plates of composite material. Analysis of composite cylindrical shells under axially symmetric loads.

Suggested Readings:

1. Jones, R.M., 'Mechanics of Composite Materials', Mc-Graw Hill Co., 1967.
2. Calcote, L.R., 'The Analysis of Laminated Composite Structures', Van Nostrand, 1969.

3. Whitney. I.M., Daniel, R.B. Pipes, 'Experimental Mechanics of Fibre Reinforced Composite Materials', Prentice Hall, 1984.
4. Hyer. M.W., 'Stress Analysis of Fibre-Reinforced Composite Materials', McGraw Hill Co., 1998.
5. Carl. T.Herakovich, 'Mechanics of Fibrous Composites', John Wiley Sons Inc., 1998.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core/Elective</th></tr>
<tr><td>PE 824 ME</td><td colspan="6">NON-DESTRUCTIVE TESTING</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours Per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>-</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives: Student has to understand the

- Need, basic concepts and technologies of Non Destructive Testing (NDT)
- Security precautions from Radiography, protection from radiation and measurement ofradiation received by personnel.
- Technology of acoustic emission (AE), the associated instrumentation and applications
- Technologies like neutron radiography; laser induced ultrasonics, surface analysis andthermography
- Merits and demerits of the different NDT Technologies
- Latest research and developments in NDT

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

- the knowledge of different NDT techniques.
- clear understanding of liquid penetrant inspection and magnetic particle inspection.
- view and interpret radiographs, utilize the various principles of radiography for differentcomponents of different shapes.
- the knowledge of acoustic emission for NDT and the instrumentation used for NDT.
- the ability to analyze and prepare a technical report.
- the knowledge of latest research, developments and trends in NDT.

UNIT-I

Liquid penetrate inspection: Principles of penetrate inspection, characteristics of a penetrate,water washable system, post emulsification system , solvent removable system, surfacepreparation and cleaning, penetrate application, development, advantages limitations, andapplications.Magnetic particle instruction: Principle, magnetization methods, continuous and residual methods, sensitivities, demagnetization, magnetic particles, applications advantages andlimitations.

UNIT-II

Eddy current testing: Principle, lift-off factor, and edge effect, skin effect, inspection frequency,coil arrangements, inspection probes, types of circuit, reference pieces, phase analysis, displaymethods and applications.

UNIT-III

Ultrasonic testing: Generation of ultra sound, characteristics of an ultrasonic beam, sound wavesat interfaces, sound attenuation, display systems, probe construction, type of display, inspectiontechniques, identification of defects, Immersion testing , sensitivity and calibration. Referencestandards. Surface condition, Applications.

UNIT-IV

Radiography: Principle and uses of radiography, limitation principle, radiation sources,production of X-Rays, x-ray spectra, attenuation of radiation, radiographic equivalence, shadowformation enlargement and distortion, radio graphic film and paper, Xeroradiography,fluoroscopy, exposure factors, radiographic screens, identification markers and image qualityindicators, inspection of simple shapes, inspection of complex shapes, viewing and interpretationof radiographs, radiation hazard, protection against radiation, measurement of radiation receivedby personnel.

UNIT-V

Acoustic Emission: Physical Principles, Sources of emission, instrumentation and applications,Other NDT Techniques: Neuron radiography, Laser induced ultrasonics, surface analysis, andthermography.

Suggested Readings:

1. Barry Hull & Vernon John, *Non Destructive Testing*, 1988.
2. H J Frissell (Editorial Coordinator), Non-*Destructive Evaluation and quality control*,ASM handbook-International Publication USA, 1989.
3. Dove and Adams, *Experimental Stress analysis and Motion Measurement*, Prentice Hallof India, Delhi

Suggested Reading:

1. *Non-Destructive Examination and Quality Control*, ASM International, Vol.17, 9thedition (1989)
2. J. Prasad and C. G. K. Nair, *Non-Destructive Test and Evaluation of Materials*, TataMcGraw-Hill Education, 2nd edition (2011).
3. B. Raj, T. Jayakumar and M. Thavasimuthu, Practical *Non Destructive Testing*, AlphaScience International Limited, 3 rd edition (2002).
4. T. Rangachari, J. Prasad and B.N.S. Murthy, *Treatise on non-destructive testing andevaluation*, Navbharath Enterprises, Vol.3, (1983).

Course Code	Course Title						Core/Elective
PE 831 ME	POWER PLANT ENGINEERING						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives: Student has to understand the
- Operation of steam turbine and gas turbine power plants
- About hydraulic power plant, hydrology, dams and spillways
- Various types of nuclear power plants including Pressurized water reactor, Boiling water reactor, Liquid metal fast breeder reactor and Gas cooled reactor
- The power plant economics
- The environmental and safety aspects of power plant operation.

Course Outcomes: At the end of the course, the students will be able to demonstrate
- Select coal and ash handling methods for a coal fired power plant.
- Comprehend basic working principle of steam and gas turbine power plant
- Classify Dams and Spillways.
- Demonstrate the basic principles of thermal-fission and fast-breeder nuclear power plants, such as pressurized- water, boiling-water, and heavy-water reactors.
- Analyse load factor, capacity factor, average load and peak load on a power plant.
- Illustrate the control methods of major pollutants emitted from fossil-fuel power plants.

UNIT-I

Introduction to Sources of Energy-Resources and Development of Power in India. Steam Power Plant: Plant layout, working of different Circuits, Fuel and handling equipment, types of coal, coal handling, choice of handling equipment, coal storage, ash handling systems.

UNIT-II

Combustion Process: Properties of coal- overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers, and heat rejection, corrosion and feed water treatment.

Gas Turbine Power Plant: Introduction -classification-Layout with auxiliaries-Principles of working of closed and open cycle gas turbines

UNIT-III

Hydro Electric Power Plant: Water power-Hydrological cycle, flow measurement- drainage area characteristics-Hydrographs-storage and pondage- classification of dams and spill ways.

UNIT-IV

Nuclear Power Station: Nuclear fuel-breeding and fertile materials -Nuclear reactor-reactor operation-Pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breeder reactor, homogeneous reactor, gas-cooled reactor.

Radiation hazards and shielding -radio active waste disposal.

UNIT-V

Power Plant Economics and Environmental Considerations: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, average load and load factor, delivery factor-related exercises Effluents from power plants and impact on environment -Pollutants and Pollution Standards -Methods of pollution control

Suggested Readings:

1. Rajput, RK, *A Text Book of'Power Plant Engineering* , 3rd Edition.Laxmi Publications, New Delhi.
2. Arora SC, Domukundwar S, *A Course in Power Plant Engineering,*DhanapatRai& Sons, New Delhi.

3. YadavR, *Steam & Gas Turbines and Power Plant Engineering,* 7th Edition, Central Publishing House, Allahabad, 2007.
4. Nag P K, *Power Plant Engineering,* 2nd Edition, Tata McGraw Hills Co. Ltd, New Delhi, 2002.
5. Wakil M M, *Power Plant Technology*, Me Graw Hill Publications, New york, 2005.

Course Code	Course Title						Core/Elective
PE 832 ME	**ROBOTIC ENGINEERING**						**Elective**
Prerequisite	**Contact Hours Per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives: Students will understand

- The configuration, work envelop and motion controls and applications
- Familiarities with the kinematics of robots.
- Robot end effectors and their design.
- Familiarities with the dynamics of robots.
- Robot Programming methods & Languages of robot.
- Various Sensors and drives and their applications in robots

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

- Equipped with robot anatomy, work volume and robot applications
- Familiarized with the kinematic motions of robot
- Having good knowledge about robot end effectors and their design concepts
- Familiarized with the robot dynamics
- Equipped with the Programming methods & drives used in robots
- Equipped with the principles of various Sensors and their applications in robots.

UNIT-I

Robots: History and evolution of robots, Laws of Robotics, basic configuration, degree offreedom, work envelope, motion control methods, Application in industry, material handling,loading & unloading, processing, welding & painting applications, assembly and inspection,Robot specification requirements

UNIT-II

Rotation matrix: Homogenous transformation matrix, Denavit-Hartenberg convention, Eulerangles, RPY reprensation, Direct and inverse kinematics for industrial robots for position andorientation, Redundancy

UNIT-III

Manipulator Jacobian: Joint, End effector velocity, direct and inverse velocity nalysis,Trajectory Planning, interpolation, cubic polynomial, linear segments with with parabolicblending, static force and moment transformation, solvability, stiffness, singularities

UNIT-IV

Robot dynamics: Lagrangian formulation, link inertia tensor and manipulator inertia tensor,Newton-Euler formulation for RR & RP manipulators, Control: Individual joint, computedtorque

UNIT-V

End effectors: position and velocity measurement, Sensors: Proximity and range, tactile, forceand torque, Drives for Robots: Electrical, Hydraulic and Pneumatic, Robot vision: Introductionto technique, image acquisition and processing, introduction to robot programming languages.

Suggested Reading:

1. Spong and Vidyasagar, *Robot Dynamics and Control*, John Wile and Sons, 1990
2. R.K. Mittal, I.J. Nagrath, *Robotics and control*, Tata Mcgraw-Hill PublishingCompany Ltd. 2003
3. Groover, *Industrial Robotics*, Mcgraw-Hill Publishing Company Ltd. 2003
4. Asada and Siotine, *Robot analysis and Intelligence*, Wiley Interscience, 1986

5. K.S. Fu GonZalezRC., lEEc.S.G., *Robotics, Control Sensing Vision and Intelligence*,McGraw Hill, Int. Ed., 1987
6.Richard S. Paul, *Robot Manipulators: Mathematics, Programming, and Control*, MITPress (MA)

Course Code	Course Title						Core/Elective
PE 833 ME	TOOL DESIGN						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives: Students will understand
- Various forces involved in the machining operations
- heat generation in machining & coolant operation
- tools, jigs and fixture, suitable for a particular machining operation

Course Outcomes: At the end of the course, the students will be able to
- Calculate the values of various forces involved in the machining operations
- Design various single and multipoint cutting tools
- Analyze heat generation in machining & coolant operation
- Illustrate the properties of various cutting toolmaterials and hence select an appropriate tool material for particular machining application
- Identify appropriate combination of tools, jigs and fixture, suitable for a particular machining operation
- Design assembly of jigs and fixtures on simplework-piece

UNIT-I

Metal Cutting : Classification of metal cutting operations, mechanics of metal cutting, tool signature, built up edge formation, mechanism of chip formation, types of chips, oblique and orthogonal cutting - Merchant's force diagram, two component tool dynamometer, Merchant's theory of metal cutting, Lee andSchaffler's theory of metal cutting.

UNIT-II

Tool Wear and Tool Life : Sources of heat in metal cutting, heat dissipation and distribution to chip, tool and work piece, methods of evaluating temperature at tool-chip interface. Machinability, factors affecting machinability, Taylor's tool life equation, crater wear and flank wear, mechanics of tool wear and various types of tool failure. Effects of tool geometry, feed, depth of cut, cutting speed on tool wear.

UNIT- III

Cutting Tool Materials : Essential requirements of a tool material, tool materials - HCS, HSS, Cast alloys, Carbides, Ceramic tools, Diamond tool bits. Essential requirements of a good cutting fluid, types of cutting fluids and their relative applications. Economics of machining - introduction, economic tool life, optimal cutting speed to maximum production and maximum profit.

Unit - IV

Press Tools : Press tool design - press operations, press working terminology, working of cutting die press operations - strip layout, punching, blanking-center of pressure, drawing and deep drawing, bending dies and forging - forging die design.

Unit - V

Jigs and Fixtures: Design of jigs and fixtures. Locating devices, clamping devices, principles of design of jigs and fixtures, some examples

Design of Cutting Tools: Broach design, elements of twist drill, HSS twist drill design, design of rotary milling cutter. Design of single point cutting tool.

Suggested Reading:

1. Donaldson [2001], Tool Design, TMH Publishers, New Delhi.
2. Roy A. Lindberg [2002], Processes and Materials of Manufacture, PHI Publishers, New Delhi.
3. G. R. Nagpal [2004], Tool Engineering & Design, Khanna Publishers, New Delhi.
4. ASTME [1987], Fundamentals of Tool Design, PHI Publishers, New Delhi.
5. AmithaGhose and Mallik [2004], Manufacturing Science, EWP Publishers, New Delhi.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core/Elective</th></tr>
<tr><td>PE 834 ME</td><td colspan="6">PRODUCT DESIGN AND PROCESS PLANNING</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours Per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>-</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives:

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

- Identify the functions of design of a product in a system in a given situation and select a suitable product ; identify the procedure for technological innovation of a product; explain the importance of brainstorming and Delphi techniques in innovation
- Explain the importance of design, human machine interaction in project selection and evaluation methods including ergonomic considerations
- Explain the importance of research in new product development; describe the process of patenting including search of patents, patent laws and international code and discriminate the scope of IPR for a product patent.
- Discuss the features of design of a new product with respect to manufacture, quality testing and marketing; and steps to evaluate a new product for introduction;
- Develop process planning including creating process sheets; explain value engineering, group technology and concurrent engineering in the selection of manufacturing process.

UNIT-I

Product Design and Process Design functions. Selection of right product. Systematic procedure of product innovation. Factors contributing to successful technological innovation - need for creativity and innovation. Techniques of innovation like brain storming and Delphi techniques.

UNIT-II

Project Selection and Evaluation: Function of design - Design withHuman Machine Interaction (HMI). Collection of ideas and purpose of project. Selection criteria - screening ideas for new products using evaluation techniques. Principles of ergonomics.

UNIT-Ill

New Product Development: Research and new product development.Patents, definitions, patent search, patent laws, international code for patents -Intellectual Property Rights (IPR).

UNIT-IV

New **Product Planning** : Interaction between the functions of design, manufacture, quality, testing and marketing. Steps for introducing new products after evaluation.

UNIT-V

Process Planning : Process planning, process sheets, selection of manufacturing process, estimation of machining time in various cutting operations - estimation of costs for manufacture. Value engineering in product design, group technology, concepts of concurrent engineering.

Suggested Reading:

1.Niebel BW & Draper AB: *Production Design & Process Engg,*McGraw Hill, Kogakusha, 1974.
2.Harry Nystrom, *Creativity and Innovation,* John Wiley & Sons,
3.BrainTwiss, *Managing Technological Innovation,*Pittrnan Publications, 1992.
4.Harry, B.Waton, *New Product Planning,* Prentice Hall Inc., 1992.
5.Chitale, A. K. & Gupta RC., *Product Design & Manufacturing,*PHI, 1997.

Course Code	Course Title						Core/Elective
PE 841 ME	INTELLECTUAL PROPERTY RIGHTS						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives: Students will understand
- Fundamental aspects of IP
- Aspects of IPR acts.
- Awareness of multi disciplinary audience
- Awareness for innovation and its importance
- The changes in IPR culture
- About techno-business aspects of IPR

Course Outcomes: At the end of the course, the students will be able to
- Will respect intellectual property of others
- Learn the art of understanding IPR
- Develop the capability of searching the stage of innovations.
- Capable of filing a patent document independently.
- Completely understand the techno-legal business angle of IP. .
- Capable of converting creativity into IP and effectively protect it.

UNIT-I

Overview of Intellectual Property: Introduction and the need for intellectual property right(IPR), IPR in India – Genesis and Development, IPR abroad, Some important examples of IPR.Importance of WTO, TRIPS agreement, International Conventions and PCT

Patents: Macro economic impact of the patent system, Patent and kind of inventions protectedby a patent, Patent document, How to protect your inventions. Granting of patent, Rights of apatent, how extensive is patent protection. Why protect inventions by patents. Searching a patent,Drafting of a patent, Filing of a patent, the different layers of the international patent system,(national, regional and international options), compulsory licensing and licensers of right & revocation, Utility models, Differences between a utility model and a patent. Trade secrets andknow-how agreements

UNIT-II

Industrial Designs: What is an industrial design. How can industrial designs be protected? Whatkind of protection is provided by industrial designs? How long does the protection last? Whyprotect industrial designs?

UNIT-III

Trademarks: What is a trademark, Rights of trademark? What kind of signs can be used astrademarks. Types of trademark, function does a trademark perform, How is a trademarkprotected? How is a trademark registered. How long is a registered trademark protected for?How extensive is trademark protection. What are well-known marks and how are they protected?Domain name and how does it relate to trademarks? Trademark infringement and passing off.

UNIT-IV

Copyright: What is copyright. What is covered by copyright. How long does copyright last?Why protect copyright? Related Rights: what are related rights. Distinction between related rights and copyright. Rights covered by copyright? Copy rights in computer programming.

UNIT-V

Enforcement of Intellectual Property Rights: Infringement of intellectual property rightsEnforcement Measures Emerging issues in Intellectual property protection. Case studies ofpatents and IP Protection.
Unfair Competition: What is unfair competition. Relationship between unfair competition andintellectual property laws.

Suggested Reading:

1. AjitParulekar and Sarita D' Souza, *Indian Patents Law – Legal & Business Implications*;Macmillan India ltd , 2006
2. B. L.Wadehra; *Law Relating to Patents, Trade Marks*, *Copyright*, *Designs &Geographical Indications*; Universal law Publishing Pvt. Ltd., India 2000
3. P. Narayanan*; Law of Copyright and Industrial Designs*; Eastern law House, Delhi 2010
4. Cronish W.R1 *Intellectual Property; Patents, copyright, Trad and Allied rights*, Sweet &Maxwell, 1993.
5. P. Narayanan, *Intellectual Property Law*, Eastern Law Edn., 1997.
6. Robin Jacob and Daniel Alexander, *A Guide Book to Intellectual Property Patents,Trademarks, Copy rights and designs*, Sweet, Maxwell 4th Edition.

Course Code	Course Title						Core/Elective
PE 842 ME	ADDITIVE MANUFACTURING TECHNOLOGY						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives: Students will understand

- the importance of RPT
- Apply various liquid and solid based RPT Systems
- Apply various powder based RPT systems and rapid tooling
- Recognize various STL formats and slicing methods and tessellation
- Application of RPT in Engineering, Jewelry and Bio medical etc.

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

- understand the developments of RPT and its terminology, Advantages and limitations of RPT
- understandmechanism involved in stereo lithography apparatus system, and terminated object manufacturing, fused deposition modeling and their applications.
- understandmechanism in selective laser interims and its application. Understand the importance of Rapid tooling
- recognizevarious types of file format and slicing methods in RP and various software available to convert 3D models.
- apply RPT in various fields of Engineering

UNIT-I

Introduction: Prototyping fundamentals, Historical development, fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used terms, classification of RP process, Rapid prototyping process chain: Fundamental Automated processes, process chain.

UNIT-II

Liquid based rapid prototyping 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 rapid prototyping systems: Laminated 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 Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Three dimensional printing (3DP): Models and specification, process, working principle, applications, advantages and disadvantages, case studies.

Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling VsRt, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, investment casting, spin casting, die csting, sand casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP

UNIT-IV

Rapid Prototyping 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
RP Applications: Application – Material Relationship, application in design, application in engineering, Analysis and planning, aerospace industry, automatic industry, Jewelry industry, coin industry, GIS application, Arts and Architecture. **RP Medical and Bioengineering Application:** Planning and simulation of complex surgery, customized implant and prosthesis, design and production of medical devices, forensic science and anthropology, visualization of biomolecules.

Suggested Readings:

1. Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles an Applications, World Scientific publications, 3rd Ed., 2010
2. D.T. Pham and S.S. Dimov, "Rapid Manufacturing", Springer, 2001
3. Terry Wohlers, " Wholers Report 2000", Wohlers Associates, 2000
4. Paul F. Jacobs, " Rapid Prototyping and Manufacturing"–, ASME Press, 1996
5. Ian Gibson, Davin Rosen, Brent Stucker "Additive Manufacturing Technologies, Springer, 2nd Ed, 2014

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core/Elective</th></tr>
<tr><td>PE 843 ME</td><td colspan="6">MACHINE TOOL ENGINEERING AND DESIGN</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours Per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>-</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
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Course Objectives: Students will understand

- Types of tools for heavy machining processes
- Design elements in sheet metal operation
- Use of jigs and fixtures for automation in industries

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

- Understand basic motions involved in a machine tool.
- Design machine tool structures
- Design and analyze systems for specified speeds and feeds
- Understand control strategies for machine tool operations
- Apply appropriate quality tests for quality assurance

UNIT-I

Classification of Machine Tools: General purpose, Special purpose, Automatic, Semi-Automatic machine tools, Transfer lines. Kinematics of Machine Tools: Shaping of geometrical and real surfaces, Developing and designing of kinematics schemes of machine tools, Kinematic structures of lathe, drilling, milling, relieving lathe, grinding, gear shaping and gear hobbing machining. Kinematic design and speed and feed boxes. Productivity loss. Stepped and stepless regulation.

UNIT-II

Strength and Rigidity of Machine Tool Structures: Basic principles of design for strength. Different types of structures. General design procedures. Effect of materials and shape factors on the rigidity of structure, overall compliance of machine tool. Design of beds, bases columns, tables, cross rails for various machines. Effect of wear of guide ways on the performance. Various types of guide ways, their relative advantages. Materials for machine tool components including plastic guide ways (PTFE).

UNIT-III

Analysis of Spindles, Bearing and Power Screws: Design of spindles subjected to combined bending and torsion. Layout of bearings. Pre-loading. Anti-friction slide ways. Rolling contact, hydrodynamic, hydrostatic, aerostatics and magnetic bearings, their relative performance. Power Screws, Recirculating ball screws. Hydrodynamic design of journal bearings.

UNIT-IV

Machine Tool Vibrations: Effect of vibration on machine tool; Forced vibrations. Machine tool chatter. Self excited vibration and dynamic stability single and two degree freedom analysis. Comply coefficient. Elimination of vibration. Vibration analysis of machine tool structures.

UNIT-V

Hydraulic Systems: General principles, hydraulic fluid power lines. Properties of hydraulic fluid. Various positive displacement pumps, their characteristics and operation. Design of hydraulic tanks and other systems. Various valves used in hydraulic systems. Design and application of various hydraulic circuits. One position and multi-position scheme. Single and multi pump screws. Electrical analogy. Pneumatic circuits. Hydro copying system. Evaluation of machine tools with regard to accuracies, sound and vibration. Machine tool testing.

Suggested Reading:

1. Sen and Bhattacharya, Principles of Machine Tools, New Central Book Agency, Calcutta, 1975.
2. S.K. Basu, Design of Machine Tools, Allied Publishers, India, 1961.
3. Acharkan, Machine Tool Design(vol. 1,2 & 3), MIR Publishers, Moscow, 1973.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core/Elective</th></tr>
<tr><td>PE 844 ME</td><td colspan="6">ENTREPRENEURSHIP DEVELOPMENT</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours Per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>-</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives:

Course Outcomes:

- Understand Indian IndustriaI Environment, Entrepreneurship and Economic growth, Small and Large scale Industries, Types and forms of enterprises.
- Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
- Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
- Apply the concepts of Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques
- Understand the Behavioral aspects of entrepreneurs, Time Management, Various approaches of time management, their strengths and weakness. The urgency addiction and time management matrix.

UNIT-I

Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.

UNIT-II

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

UNIT-III

Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis, project financing in India.

UNIT-IV

Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of tax burden.

UNIT-V

Behavioural aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

Suggested Readings:

1.Vasant Desai, *"Dynamics of Entrepreneurial Development andManagement",* Himalaya Publishing House, 1997.
2.Prasanna Chandra, *"Project-Planning, Analysis, Selection,Implementation and Review",* Tata Mcgraw-Hill Publishing CompanyLtd. 1995.
3.Stephen R. Covey and A. Roger Merrill, *"First Things First",* Simon and Schuster Publication, 1994.
4.G.S. Sudha, *"Organizational Behaviuor",* 1996.

5.Robert D. Hisrich, Michael P. Peters, *"Entrepreneurship",* Tata Me Graw Hill Publishing Company Ltd., 5^{lh} Ed., 2005.

Course Code	Course Title						Core/Elective
PC 851 ME	SEMINAR						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1
Course Objectives:							

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of state of the art topics in a broad area of *hisI*her specialization.

Seminar*topics*may he chosen by thestudentSwith advice from the faculty members. Students are to be exposed to following aspects of seminar presentations.

Literature surveyOrganisationof material

Preparation of OH!' slides*I*PC presentation Technical writing.

Eachstudent will be required to

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Give a 20 minutes presentation through OHP,PC. Slide projector followed by 10 minutes discussion.
3. Submit a report on the seminar topic with list of references and slides used.

Seminars are to be scheduled from the 3 week to the last week of the semester and any change in schedule should be discouraged.

TheSessionalsmarks will be awarded to the students by at least 2 faculty members on the basis of an average of written presentation as well as their involvement in the discussions.

Course Code	Course Title						Core/Elective
PC 852 ME	PROJECT						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1
Course Objectives:							

Solving a real life problem should be the focus of U.G. project. Faculty members should prepare project briefs well in advance. They should be made available to the students at the Department Library. A project may be classified as hardware / software / modeling / simulation. It should involve elements such as analysis, design and synthesis.

The Department will appoint a project coordinator who will be in-charge of the following

- Grouping of students (Maximum of three in a group).
- Allotment of projects and project guide.
- Project monitoring at regular intervals.

A project allotment is to be completed by the 4^{th} week of 1^{s1} semester of IV year so that students get sufficient time for completion of their project.

All the projects are to be checked for progress at least twice in a semester. It should be on the basis of presentation of the students.

Sessionals marks to be based on the Grade / Marks awarded by a monitoring committee comprising of faculty members as well as by the supervisor.

Efforts to be made so that some of the projects are carried out in industries. Projects may also be invited from industries.

Norms of final documentation of the project report are to be provided by the Department.

**** Excellent / Very Good / Good / Satisfactory / Unsatisfactory.***

Note : Three periods of contact load will be assigned to each projectguide.

Course Code	Course Title						Core/Elective
	MECHATRONICS						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives: Student has to understand the
- How to identify, formulate, and solve engineering problems
- The design a system, component, or process to meet desired needs within realistic constraints
- The how to use the techniques, skills, and modern engineering tools necessary for engineering practice
- The use of drive mechanisms and fluid power systems
- The use of industrial electronic devices
- The demonstrate the design of modern CNC machines, and Mechatronics elements

Course Outcomes: At the end of the course, the students will be able to
- Model and analyze electrical and mechanical systems and their interconnection
- Integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems
- Do the complete design, building, interfacing and actuation of a mechatronics system for a set of specifications
- Be proficient in the use of fluid power systems in various mechatronics applications
- Demonstrate the use of industrial electronic devices
- Demonstrate the design of modern CNC machines, and mechatronics elements

UNIT-I

Introduction to mechanization & automation: Need of interface of electrical & electronic devices with mechanical elements, the concept of Mechatronics, Flow chart of Mechatronics system, elements of Mechatronics system, drive mechanisms, actuators, feedback devices and control system, application in industries and systems development

UNIT-II

Drive mechanisms: Feeding and indexing, orientation, escapement and sorting devices, conveyor systems Introduction to electrical actuators: A.C. servomotors, D.C. servomotors, stepper motors

UNIT-III

Introduction to fluid power systems: Industrial Pneumatics and hydraulics, merits of fluid power, pneumatic & hydraulic elements symbols, study of hydraulic control valves, pumps & accessories, hydraulic circuits & mechanical servo control circuits, Electro-hydraulic and Hydropneumatic circuits

UNIT-IV

Introduction to industrial electronic devices: Diodes, Transistors, Silicon Controlled Rectifiers (SCR), Integrated Circuits (IC), Digital Circuits, Measurement systems & Data acquisition systems: sensors, digital to analog and analog-to-digital conversion, signal processing using operational amplifiers, introduction to micro processor & micro controller, Temperature measurement interface and LVDT interface, Systems response

UNIT-V

Design of modern CNC machines and Mechatronics elements: machine structures, guide ways, spindles, tool monitoring systems, adaptive control systems, Flexible manufacturing systems, Multipurpose control machines, PLC programming

Suggested Readings:

1. William Bolton, Mechatronics: Electronic control systems in mechanical and electrical engineering, 6th edition, Pearson Education
2. HMT Ltd, Mechatronics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1998
3. Michaels Histand& David G, Alciatore, Introduction to Mechatronics and Measurement Systems, Tata McGraw-Hill International Edition
4. Devdas Shetty, Richard A. Kolk, Mechatronics System Design, Cengage Learning
5. S.R. Majumdar, Oil Hydraulic Systems – Principles & Maintenance, McGraw-Hill Publishing Company Limited, New Delhi
6. Godfrey Onwubolu, Mechatronics: Principles and Applications, Butterworth-Heinemann

FACULTY OF ENGINEERING

Scheme of Instruction & Examination

(CBCS Curriculum for the Academic Year 2019-2020)

and

Syllabi

B.E. VII and VIII Semester

of

Four Year Degree Programme

In

Production Engineering

(With effect from the academic year 2019– 2020)
(As approved in the faculty meeting held on 25-06-2019)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad – 500 007

2019

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VII - Semester
(PRODUCTION ENGINEERING)

S.No	Course Code	Course Title	Scheme of Instruction			Contact Hr/Wk	Scheme of Examination			Credits
			L	T	P/D		CIE	SEE	Duration in Hours	
Theory Courses										
1	PC 701 MP	Tool Design	3	1	-	4	30	70	3	4
2	PC 702 ME	Finite Element Analysis	3	1	-	4	30	70	3	4
3	PC 703 ME	Industrial Engineering	3	-	-	3	30	70	3	3
4	PC 704 ME	Production and Operations Management	3	-	-	3	30	70	3	3
5	HS 401 CM	Managerial Economics and Accountancy	3	-	-	3	30	70	3	3
6	OE – II	Open Elective-II	3	-	-	3	30	70	3	3
Practical / Laboratory Courses										
7	PC 751 MP	CAME Lab	-	-	2	2	25	50	3	1
8	PC 752 ME	CAE Lab	-	-	2	2	25	50	3	1
9	PC 753 ME	Project Seminar	-	-	2	2	25	50	-	1
Total			18	2	6	26	255	570	-	23

Open Elective –II Course Code	Course Title
OE 824 ME	Entrepreneurship

MC: Mandatory Course **PC**: Professional Course **HS**: Humanities and Sciences
L: Lectures **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)
Note:

1. Each contact hour is a Clock Hour
2. The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

Course Code	Course Title						Core/Elective
PE 701 MP	TOOL DESIGN						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	3

Course Objectives: Students will understand
- Various forces involved in the machining operations
- heat generation in machining & coolant operation
- tools, jigs and fixture, suitable for a particular machining operation

Course Outcomes: At the end of the course, the students will be able to
- Calculate the values of various forces involved in the machining operations
- Design various single and multipoint cutting tools
- Analyze heat generation in machining & coolant operation
- Illustrate the properties of various cutting tool materials and hence select an appropriate tool material for particular machining application
- Identify appropriate combination of tools, jigs and fixture, suitable for a particular machining operation
- Design assembly of jigs and fixtures on simplework-piece

UNIT-I

Metal Cutting : Classification of metal cutting operations, mechanics of metal cutting, tool signature, built up edge formation, mechanism of chip formation, types of chips, oblique and orthogonal cutting - Merchant's force diagram, two component tool dynamometer, Merchant's theory of metal cutting, Lee andSchaffler's theory of metal cutting.

UNIT-II

Tool Wear and Tool Life : Sources of heat in metal cutting, heat dissipation and distribution to chip, tool and work piece, methods of evaluating temperature at tool-chip interface. Machinability, factors affecting machinability, Taylor's tool life equation, crater wear and flank wear, mechanics of tool wear and various types of tool failure. Effects of tool geometry, feed, depth of cut, cutting speed on tool wear.

UNIT- III

Cutting Tool Materials : Essential requirements of a tool material, tool materials - HCS, HSS, Cast alloys, Carbides, Ceramic tools, Diamond tool bits. Essential requirements of a good cutting fluid, types of cutting fluids and their relative applications. Economics of machining - introduction, economic tool life, optimal cutting speed to maximum production and maximum profit.

Unit - IV

Press Tools : Press tool design - press operations, press working terminology, working of cutting die press operations - strip layout, punching, blanking-center of pressure, drawing and deep drawing, bending dies and forging - forging die design.

Unit - V

Jigs and Fixtures: Design of jigs and fixtures. Locating devices, clamping devices, principles of design of jigs and fixtures, some examples
Design of Cutting Tools: Broach design, elements of twist drill, HSS twist drill design, design of rotary milling cutter. Design of single point cutting tool.

Suggested Reading:

1. Donaldson [2001], Tool Design, TMH Publishers, New Delhi.
2. Roy A. Lindberg [2002], Processes and Materials of Manufacture, PHI Publishers, New Delhi.
3. G. R. Nagpal [2004], Tool Engineering & Design, Khanna Publishers, New Delhi.
4. ASTME [1987], Fundamentals of Tool Design, PHI Publishers, New Delhi.
5. AmithaGhose and Mallik [2004], Manufacturing Science, EWP Publishers, New Delhi.

Course Code	Course Title						Core/Elective
PC702ME	FINITE ELEMENT ANALYSIS						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
EM, MOM, FM, HT	3	1	-	-	30	70	3

Course Objectives:

Course Outcome:

- Summarize basic equations of elasticity and formulate finite element modeling of one dimensional element using Potential energy approach.
- Formulate finite element modeling of truss and frame elements along with the concepts of transformation from local to global matrices.
- Interpolate Hermitian shape function of beam element in natural coordinate system.
- Develop stiffness matrix for a plane stress & plane strain conditions on a CST, Axisymmetric elements by interpolating shape functions in natural coordinate system.
- Interpolate the shape functions of Isoparametric elements and to present the use of numerical integration to evaluate the element matrices in typical 2D problems. Formulate finite element model to steady state heat transfer analysis using one & two dimensional elements.
- Formulate mass and stiffness matrices of 1D & beam elements to establish Eigen values &Eigen vectors using Lagarangian and Hamilton principles. Develop finite element model for 3D problems in stress analysis and explain the concepts of convergence criteria.

UNIT-I

Introduction to Finite Element Method for solving field problems, Stress and Equilibrium, Boundary conditions, Strain, Displacement, Stress-Strain relations.

One dimensional problems:

Finite element modeling coordinates and shapes functions, Potential Energy approach: Assembly of Global stiffness matrix and load vector, Finite element equations, Treatment of boundary conditions, Galerkin's approach, Quadratic shape functions.

UNIT-II

Analysis of trusses and frames: Element stiffness matrix for a truss member, Analysis of plane truss with 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 nodes (two degrees of freedom per node).

UNIT-III

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

UNIT-IV

Two dimensional four nodediso-parametric elements and numerical integration. Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional analysis of thin plate, Analysis of circular shaft subjected to torsion.

UNIT-V

Dynamic Analysis: Formulation of finite element model, 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. Introduction to finite element formulation of three dimensional problems in stress analysis, Convergence requirements. Introduction to Finite Element Analysis Software.

Suggested Reading:

1. G.Ramamurthy, Applied Finite Element Analysis, I.K. International Publishing House Pvt.Ltd., New Delhi, 2009.
2. Tirupathi R, Chandraputla and Ashok D Belagundu, Introduction to Finite Elements in Engineering ,Prcatice Hall of India,1997.
3. Rao S S, The Finite Element Method in Engineering, Pergamon Press, 1989.
4. Segerlind L J, Applied Finite Element Analysis, Wiley Eastern, 1984.
5. Reddy JN, An Introduction to Finite Element Method, McGraw-Hill, 1984.

Course Code	Course Title						Core/Elective
PC703ME	INDUSTRIAL ENGINEERING						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives:

- To learn the concept of Management.
- To understand role of Production Planning and Control in Industry.
- To learn various material procurement policies.
- To understand importance of quality control and various methods.
- To interpret the role of Decision theory in Industry.

Course Outcomes:

- Explain various approaches for industrial management. Able to infer concept of management in human resource domain
- Apply Philosophy of Production Planning and Control in Industry and control the activities in delivering the products in time
- Determine the optimum requirement of inventory by developing the various quantitative models.
- Develop various models or methods for ensuring the required quality of the products or processes.
- Elaborate the role of Decision theory and apply various approaches under Uncertainty and Risk conditions

UNIT-I

Management: Introduction to Management, Scientific Management, Systems approach to Management, MBO, and Decision Making Process.

Personnel Management: Functions of personnel management, types of training, Job evaluation and Merit rating, Collective bargaining and labour participation in management.

UNIT-II

Production Planning & Control: Definition, Objectives, Importance and Functions of Production Planning & Control.

Production Control: Routing, Scheduling, Dispatching, Follow-up and progress Report.

UNIT-III

Inventory Control: Importance of inventory control, types of inventory models Inventory costs deterministic inventory models Basic EOQ models, production model without shortages, Purchase model with instantaneous replenishment and with shortages production model with shortages Inventory model with price breaks, Fixed order quality system, periodic review system Inventory model with probabilistic demand

UNIT-IV

Quality Control : Concept of quality, evolution of quality control, assignable and chance causes of variation, Variable Control charts (X and R charts) ,

Attributes control charts: P chart and C chart

Acceptance Sampling – Single Sampling, Double Sampling and Multi sampling plans – OC curves of single sampling plans

UNIT-V

Decision Theory : Introduction, Decision, Decision Making & Decision Theory, Types of Decisions, decision making process, Types of Decision making Environment:

Decision making under Uncertainty- Criterion of Optimism or Maximax, Criterion of Pessimism or Maximin, Minimax decision criteria

Decision making under Risk –Expected Monetary Value(EMV), Expected Opportunity Loss (EOL) Criterion & Expected Value of Perfect Information(EVPI) Criterion
Decision Trees

Suggested Reading:

1. M.Mahajan, *"Industrial Engineering and Production Management"*, Dhanpatrai& sons, New Delhi
2. S.K.Sharma and Savitasarma, *"Industrial Engineering and Organization Management"*, SK Kataria& Sons, New Delhi.
3. S.D. Sharma, "*Operations Research*", Kedarnnath, Ramnath& Co., Meerut, 2009
4. S Kalavathi, "*Operations Research"*, Vikas Publishing House Pvt. Ltd, 2009
5. V. K. Kapoor , "*Operations Research"*, S. Chand, New Delhi.
6. SK Sharma &Savita Sharma," A course in Industrial Engineering & Operations Management", S K Kataria& Sons, 2008.

Course Code	Course Title						Core/Elective
PC704ME	PRODUCTION AND OPERATIONS MANAGEMENT						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives:

- To understand the concept of Production & Operations Management.
- To understand role of work study and work measurement in Industry.
- To learn use of forecasting and various methods of it.
- To understand importance Aggregate planning, Materials Requirement Planning for Industry.
- To understand Project Management approaches in completion of Project.

Course Outcomes:

- Explain various types of Production Systems, develop suitable layout for a given plant
- Develop various methods for work study and apply suitable Recording techniques. Develop standard procedures and time for the operations.
- Explain necessity of Forecasting and various methods of it. Develop suitable quantitative forecasting technique for the given past data. Compare accuracy of models in connection with forecast errors.
- Explain Aggregate planning & Mater scheduling, Materials Requirement Planning Processes. Develop quantitative models for Material requirement and resources based on time span.
- Elaborate the usages of PERT/CPM techniques for a give project and develop suitable quantitative model for the project in successful competition by identifying the time constraints for start and end of process activities.

UNIT-I

Production & Operations Management: Introduction, Types of production Systems. Job shop, Batch, Flow shop.

Plant location and layout: Factors affecting plant location, Break even analysis, plant layout objectives, Types of layouts, merits and demerits.

UNIT-II

Work Study: Introduction to method study, Steps in method study, Recording techniques- Flow process chart, String diagram, Therbligs, Principles of motion economy.

Work measurement: Stop watch time study, Standard time calculation. Work sampling- procedure, applications, advantages and disadvantages, Wages and incentives, types of incentive plans.

UNIT-III

Forecasting: Introduction, Forecasting objectives and uses, demand patterns, Qualitative models Market survey, Delphi Tech, Quantitative models, Moving average, Weighted moving average, Simple exponential smoothing, trend adjusted exponential smoothing, Least square method, Simple regression, multiple regression.

Forecast errors: Mean absolute Deviation (MAD), Mean Square Error (MSE), Mean Forecast Error(MFE), Mean absolute percentage error (MAPE).

UNIT-IV

Aggregate Planning and Master Scheduling: Introduction, objectives of aggregate planning, Cost in aggregate planning, Strategies in aggregate planning, Master production scheduling.

Materials Requirement Planning MRP 1: Importance of MRP, MRP system inputs and outputs, MRP calculations

Manufacturing Resource Planning MRP 2 & Enterprise Resource Planning (ERP): Features of ERP packages like SAP,BANN, People soft etc.,

UNIT-V

Project Management: Project management: Network fundamentals, difference between PERT/CPM Scheduling the activities. Fulkerson's rule. Earliest and latest times. Determination of ES and EF in the forward path. LS and LF in backward path. Determination of critical path. Free float, independent float, Total float, Program evaluation and review technique, crashing of network.

Suggested Readings:

1. Joseph Monk, *Operations Management*, TMH Publishers, New Delhi, 2004.
2. Buffa Elwood S, *Modern Production / Operations Management,* John Wiley Publishers, Singapore, 2002.
3. Everett E Adam, Jr and Ronald J. Ebert, *Production and Operations Management – Concepts, Models and Behaviour,* 5th Ed. 1998, (EEE), Prentice Hall of India(P) Ltd., New Delhi.
4. PanneerSelvam R, "*Operations Research*", Second Edition, PHI Learning Pvt. Ltd. New Delhi, 2006.
5. S.D. Sharma, "*Operations Research*", Kedarnnath, Ramnath& Co., Meerut, 2009.

Course Code	Course Title						Core/Elective
HS 401 CM	MANAGERIAL ECONOMICS AND ACCOUNTANCY						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives:

- To understand responsibilities of a manager of a business undertaking.
- To analyze various factors influencing demand elasticity
- To Forecast & compute the future sales level.
- To determine Break Even Point (BEP) of an enterprise
- To understand the features, steps, merits, uses & limitations of Pay Back, ARR, NPV, PI & IRR methods of Capital Budgeting
- To understand the principles of accounting and prepare Journal, Ledger, Trial Balance, Manufacturing A/c, Trading A/c., Profit & Loss A/c. and Balance Sheet of an enterprise.

Course Outcomes:

- Determine the responsibilities of a manager of a business undertaking.
- Assess various factors influencing demand elasticity
- Able to Forecast & compute the future sales level.
- Determine Break Even Point (BEP) of an enterprise Outline the features, steps, merits, uses & limitations of Pay Back, ARR, NPV, PI & IRR methods of Capital Budgeting
- Understands the principles of accounting and prepare Journal, Ledger, Trial Balance, Manufacturing A/c, Trading A/c., Profit & Loss A/c. and Balance Sheet of an enterprise.

UNIT-I

Introduction to economics and its evolution: Managerial Economics its Scope, Importance and relation to other sciences, its usefulness to engineers-Basic concepts of Managerial Economics.

UNIT-II

Demands: Analysis-concept of demand, determinants, law of demand, its assumptions, elasticity of demand, price, income and cross elasticity, demand forecasting-markets competitive structure, price- output determination under perfect competition and Monopoly.

UNIT-III

Theory of Production: Firm and industry-production function-input-output relations-laws of returns- internal and external economics of scale. Cost analysis-Cost concepts-fixed and variable costs-explicitly and implicitly costs-out pocket of costs and imputed costs-opportunity cost-cost output relation- ship-break even analysis.

UNIT-IV

Capital management: Significance, determinates and estimation of fixed and working capital requirements, sources of capital. Introduction to capital budgeting, methods of payback and discounted cash flow methods with problems.

UNIT-V

Book-keeping: Principles and significance of double entry book keeping, journal, subsidiary books, ledger accounts, trial balance concepts and preparation of final accounts with simple adjustments- analysis and interpretation of financial statements through ratios.

Suggested Readings:

1. Varshney RL and KI Maheswari, Managerial Economics, Sultan Chand.
2. JC Pappas and EF Grigham, Managerial Economics.
3. Grawal T.S. Introduction to Accountancv.
4. Maheswari S.N. Introduction to Accountancy.
5. Panday I.M. Financial Management.

Course Code	Course Title						Core/Elective
	ENTREPRENEURSHIP						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives:

Course Outcomes:

- Understand Indian IndustriaI Environment, Entrepreneurship and Economic growth, Small and Large scale Industries, Types and forms of enterprises.
- Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
- Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
- Apply the concepts of Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques
- Understand the Behavioral aspects of entrepreneurs, Time Management, Various approaches of time management, their strengths and weakness. The urgency addiction and time management matrix.

UNIT-I

Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.

UNIT-II

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

UNIT-III

Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis, project financing in India.

UNIT-IV

Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of tax burden.

UNIT-V

Behavioural aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

Suggested Readings:

1.Vasant Desai, *"Dynamics of Entrepreneurial Development andManagement",* Himalaya Publishing House, 1997.

2.Prasanna Chandra, *"Project-Planning, Analysis, Selection,Implementation and Review",* Tata Mcgraw-Hill Publishing CompanyLtd. 1995.

3.Stephen R. Covey and A. Roger Merrill, *"First Things First",* Simon and Schuster Publication, 1994.

4.G.S. Sudha, *"Organizational Behaviuor",* 1996.
5.Robert D. Hisrich, Michael P. Peters, *"Entrepreneurship",* Tata Me Graw Hill Publishing Company Ltd., 5^{lh} Ed., 2005.

Course Code	Course Title						Core/Elective
	MECHATRONICS						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives: Student has to understand the

- How to identify, formulate, and solve engineering problems
- The design a system, component, or process to meet desired needs within realistic constraints
- The how to use the techniques, skills, and modern engineering tools necessary for engineering practice
- The use of drive mechanisms and fluid power systems
- The use of industrial electronic devices
- The demonstrate the design of modern CNC machines, and Mechatronics elements

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

- Model and analyze electrical and mechanical systems and their interconnection
- Integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems
- Do the complete design, building, interfacing and actuation of a mechatronics system for a set of specifications
- Be proficient in the use of fluid power systems in various mechatronics applications
- Demonstrate the use of industrial electronic devices
- Demonstrate the design of modern CNC machines, and mechatronics elements

UNIT-I

Introduction to mechanization & automation: Need of interface of electrical & electronic devices with mechanical elements, the concept of Mechatronics, Flow chart of Mechatronics system, elements of Mechatronics system, drive mechanisms, actuators, feedback devices and control system, application in industries and systems development

UNIT-II

Drive mechanisms: Feeding and indexing, orientation, escapement and sorting devices, conveyor systems Introduction to electrical actuators: A.C. servomotors, D.C. servomotors, stepper motors

UNIT-III

Introduction to fluid power systems: Industrial Pneumatics and hydraulics, merits of fluid power, pneumatic & hydraulic elements symbols, study of hydraulic control valves, pumps & accessories, hydraulic circuits & mechanical servo control circuits, Electro-hydraulic and Hydropneumatic circuits

UNIT-IV

Introduction to industrial electronic devices: Diodes, Transistors, Silicon Controlled Rectifiers (SCR), Integrated Circuits (IC), Digital Circuits, Measurement systems & Data acquisition systems: sensors, digital to analog and analog-to-digital conversion, signal processing using operational amplifiers, introduction to micro processor & micro controller, Temperature measurement interface and LVDT interface, Systems response

UNIT-V

Design of modern CNC machines and Mechatronics elements: machine structures, guide ways, spindles, tool monitoring systems, adaptive control systems, Flexible manufacturing systems, Multipurpose control machines, PLC programming

Suggested Readings:

1. William Bolton, Mechatronics: Electronic control systems in mechanical and electrical engineering, 6th edition, Pearson Education
2. HMT Ltd, Mechatronics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1998
3. Michaels Histand& David G, Alciatore, Introduction to Mechatronics and Measurement Systems, Tata McGraw-Hill International Edition
4. Devdas Shetty, Richard A. Kolk, Mechatronics System Design, Cengage Learning
5. S.R. Majumdar, Oil Hydraulic Systems – Principles & Maintenance, McGraw-Hill Publishing Company Limited, New Delhi
6. Godfrey Onwubolu, Mechatronics: Principles and Applications, Butterworth-Heinemann

Course Code	Course Title						Core / Elective
PC 751 MP	**Computer Aided Manufacturing Engineering LAB**						**Core**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
NIL	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

- To gain practical experience in handling 2D & 3D modeling software system.
- To study the features of CNC machine tool.
- To know application of various CNC machine.
- To understand various production processes.

Course Outcomes

At the end of the course

- Will be able to develop 3D models using modeling software.
- Will be able to understand the CNC control in modern manufacturing system.
- Will be able to distinguish between various manufacturing processes.
- Will be able to select appropriate manufacturing process to manufacture any component.

I. Computer Aided Manufacturing Practice.

1. Step turning and taper turning on CNC.
2. External multiple turning cycles.
3. Grooving and threading operation.
4. Contour milling on CNC.
5. Circular pocketing on CNC
6. Mirroring on CNC

II. Manufacturing Practice.

One / two of the following items have to be manufactured by a group of maximum three members using all the production processes.

1. Drill vice.
2. Bridge clamp
3. Plumber block
4. Piston head (flat head / cup head)
5. Spur gear with hub and key.
6. Spacer.

III. Modeling Practice using cad software.

1. Simple tail stock mechanism
2. Planetary gear system.
3. Simple jig and fixture.
4. Milling machine arbor.
5. Machine vice

Note: Assembly techniques to be done with fits and tolerances using CAD software, various exercises have to be allotted to different group of students by teaching faculty.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core/Elective</th></tr>
<tr><td>PC 752 ME</td><td colspan="6">CAE LAB</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours Per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>2</td><td>25</td><td>50</td><td>1</td></tr>
</table>

Course Objectives:

1. To introduce fundamentals of the analysis software, its features and applications.
2. To learn the basic element types in Finite Element analysis.
3. To know the concept of discretization of continuum, Loading conditions and analyse the structure using pre-processor and postprocessor conditions.

Course Outcomes:

- ➢ Classify the types of Trusses (Plane Truss & Spatial Truss) and Beams (2D & 3D) with various cross sections to determine Stress, Strains and deflections under static, thermal and combined loading
- ➢ Generalize Plane stress, plane strain conditions & axisymmetric loading on inplane members to predicting the failure behavior and finding the SCF
- ➢ Analyse connecting rod with tetrahedron and brick elements, performing static analysis on flat & curved shells to determine stresses, strains with different boundary conditions.
- ➢ Predict the natural frequencies and modes shapes using Modal, Harmonic analysis. Also finding the critical load using Buckling analysis
- ➢ Simulate steady state heat transfer analysis of chimney, Transient heat transfer of castings, Non-linear, Buckling analysis of shells &CFD analysis
- ➢ Evaluate the stiffness matrix , B matrix and loading matrices of beam/in plane/solid elements using MATLAB software

1. Analysis of Plane Truss & Spatial Truss with various cross sections and materials to determine member forces, member strains & stresses, joint deflections under static , thermal and combined loading
2. 2D & 3D beam analysis with different sections, different materials for different loads (forces and moments) with different end supports
3. Static analysis of plate with a hole to determine the deformations, the Stresses to study the failure behavior and SCF.
4. Plane stress, plane strain and axisymmetric loading on the in plane members with in plane loading to study the stresses and strains.
5. Static analysis of connecting rod with tetrahedron and brick elements
6. Static Analysis of flat and curved shell due to internal pressure and moments to estimate the strains, stresses and reactions forces and moments with different boundary conditions
7. Buckling analysis of plates, shells and beams to estimate BF and modes
8. Modal analysis of beams, plates and shells for natural frequencies and mode shapes
9. Harmonic analysis of a Shaft subjected to periodic force and transient analysis of plate subjected to stepped and ramped loading with varying time
10. Steady state heat transfer Analysis Cross section of chimney and transient heat transfer analysis of solidification of castings.
11. Non linear analysis of cantilever beam with non-linear materials at tip moment and post Buckling analysis of shells for critical loads
12. Coupled field analysis.
13. Flow analysis of pipe with different fluids/gasses/air for velocity and pressure gradients
14. CFD analysis of aerofoil design
15. CFD analysis of ducts/impeller/fan
16. Use of MATLAB for finding B matrix, stiffness matrix and loading matrices of beam/in plane/solid elements and interfacing with CAE software's

Note: 1. Any of FEA software ANSYS/ABAQUS/NASTRAN/NISA/CAEFEM/ADINA may be used
2. Any 12 experiments to be conducted

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core/Elective</th></tr>
<tr><td>PC 753 ME</td><td colspan="6">INTERNSHIP SEMINAR</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours Per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>2</td><td>25</td><td>-</td><td>-</td></tr>
<tr><td colspan="8">Course Objectives:
➢ Produce an accurate record of work performed during the Internship/Co-op
➢ Apply engineering knowledge to a problem in industry
➢ Produce a technical report
➢ Discuss work in a team environment, if relevant to the project
➢ Conduct herself/himself responsibly, safely, and ethically in a professional environment</td></tr>
</table>

Students should carefully discuss with their industry mentor the time expectations for completion of the requirements of the class, and these expectations should be clearly articulated in the Engineering Internship/Co-op Form. Typical total time on an internship/co-op is full-time at 40 hrs/week and is typically paid.

The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship/co-op

- Overview of company/project
- Safety training
- Discussions with project teams
- Background research, review of documents, white papers, and scientific papers
- Planning, designing, and reviewing the planned work
- Executing the plans
- Documenting progress, experiments, and other technical documentation
- Further team discussions to discuss results
- Final report writing and presentation

Each student will be required to

1. Submit a one page synopsis of the seminar to be delivered 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.

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

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VIII - Semester
(PRODUCTION ENGINEERING)

S.No	Course Code	Course Title	Scheme of Instruction			Contact Hr/Wk	Scheme of Examination			Credits
			L	T	P/D		CIE	SEE	Duration in Hours	
Theory Courses										
1	PE – II	Professional Elective-II	3	-	-	3	30	70	3	3
2	PE – III	Professional Elective-III	3	-	-	3	30	70	3	3
3	PE – IV	Professional Elective-IV	3	-	-	3	30	70	3	3
Practical / Laboratory Courses										
4	PC 851 ME	Seminar	-	-	2	2	25	50	-	1
5	PC 852 ME	Project	-	-	2	2	25	50	3	1
Total			9	-	4	13	140	310	-	11

Professional Elective - II

1	PE821 ME	Design of Solar Energy System	3	-	-	3	30	70	3	3
2	PE 822 PE	Total Quality Management	3	-	-	3	30	70	3	3
3	PE823 ME	Composite Materials	3	-	-	3	30	70	3	3
4	PE 824 ME	Non-Destructive Testing	3	-	-	3	30	70	3	3

Professional Elective - III

1	PE 831 ME	Additive anufacturing Technology	3	-	-	3	30	70	3	3
2	PE 832 ME	Mechanical Vibrations	3	-	-	3	30	70	3	3
3	PE 832 ME	Robotic Engineering	3	-	-	3	30	70	3	3
4	PE 834 ME	Product Design And Process Planning	3	-	-	3	30	70	3	3

MC: Mandatory Course **PC**: Professional Course **HS**: Humanities and Sciences
L: Lectures **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)
Note:

1. Each contact hour is a Clock Hour
2. The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core/Elective</th></tr>
<tr><td>PE 821 ME</td><td colspan="6">DESIGN OF SOLAR ENERGY SYSTEM</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours Per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>-</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives: Student will understand
- Understand the design concepts of solar systems.
- Design and development of solar thermal systems.
- Design of photovoltaic system and its components.
- Analyze the performance of solar energy systems.

Course Outcomes: After completing this course, students will be able to:
- Analyze the design concepts of solar systems.
- Apply the design concepts of solar systems.
- Understand various solar components
- Design and select various solar components
- Evaluate the performance solar system

UNIT-I

System conceptual design, design of major components, overall system, design of physical principles to the solar system based on application. The process includes idea generation, concepts selection and estimation, design of major components, and overall system design, solar radiation data.

UNIT-II

Design of solar thermal systems for water, space heating, cooling and power generation. f-Chart calculation method for sizing solar water and space heating systems. Design of non-focusing and focusing collectors.

UNIT-III

Design aspects of solar thermal energy storage systems. Selection criteria of storage materials for heating and cooling applications, selection of heat transfer fluid for heating and cooling applications. Design of LHTES for solar process heating and power generation applications.

UNIT-IV

Design of photovoltaic off-grid and grid- connected power systems. Design of system components - PV modules, batteries, charge controllers, inverters, auxiliaries. Performance analysis of a photovoltaic system. Using software codes for design of solar thermal and photovoltaic systems.

UNIT-V

Performance analysis of various solar thermal systems, PV system and evaluation of solar thermal energy storage system, selection of components and materials, estimation of economics. Using software tools for design of solar thermal and photovoltaic systems, case studies.

Suggested Readings:

1.Duffie .J.A and Beckman .W.A, “Solar Engineering of Thermal Process”, Wiley,3rd ed., 2006.
2.Da Rosa .A.V, “Fundamentals of Renewable Energy Processes”, 2nd ed., Academic Press, 2009.
3.Kalogirou .S.A, “Solar Energy Engineering: Processes and Systems”, Academic Press, 2009.
4.Sen .Z, “Solar Energy Fundamentals and Modeling Techniques”, Turkey, 2008.
5.Vogel .W, Kalb .H, “Large- Scale Solar Thermal Power Technologies”, Wiley-VCH, 2010.
6.Dincer .I, Rosen .M, “Thermal Energy Storage”, 2nd ed., Wiley, 2011.
7.Prasad .D, &Snow .M, “Designing with Solar Power”, Earthscan, 2005

Course Code	Course Title						Core / Elective
PE 822 MP	TOTAL QUALITY MANAGEMENT						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	3	30	70	3

Course Objectives

- To control the quality of the product.
- To satisfy the customers with the product.

Course Outcomes

At the end of the course

- Will be able to understand statistical point of view how to control quality
- Will be able to understand the market feedback, dissatisfaction, output etc

Unit-I

Strategic Quality Management: Quality policies, quality goals, obstacles to achieving successful strategic quality management.. Organization for quality role of {Top. middle, work force teem (Quality Circles). Developing, a quality work culture - Maslow need theory, Herzbeg 2 factor theory, theory X, Y & Z. Methods to create and maintaina awareness of quality, provide evidence of management leadership, types of self development and empowerment programmes, methods of participations means of inspiring action, recognition and rewards. Supplier quality rating plans (lot plot plan, OC curve, parent analysis) assignment of supplier capability, Methods of evaluating supplier products, contract management (Joint economic plan, join technological forecasting).

Unit-II

Design for quality: Basic functional requirements of quality, Design for (reliability, safety cost and product performance) concurrent engineering (DFMA) value engineering. Support for quality improvement processes (Block diagram, brain storming, cause effect analysis, pareto analysis)
Quality function deployment, reliability analysis, failure rate, failure pattern of complex products (bath tub curve) weibull distribution relationship between part and the system exponential reliability, availability, FMEA (Fracture mode and Effect Analysis) Design for experiments: Factorial experiments, construction fractional designs.

Unit-III

Technical tools for quality: Comparison of two methods: observation of data, distribution, statistical analysis, chi square test, F test. T test. Hypothesis testing significance testing, linear correlation and regression. Analysis of variance (ANOVA). 4 factor ANOVA experiment 2 levels. Analysis of means. Techniques for on line quality:: Data collection plan, variable an attribute charts, interpreting the control charts, charts for drifting processes, mufti variant charts, alternatives to statically process controls. Techniques for offline quality control: Background to Taguchi method (Quality loss and

loss function, controllable factor and non controllable factors in parameter performance, tolerance design. Taguchi Analysis Techniques: Net variation and contribution ratio, estimation of process performance. Accumulating analysis, performance measures avoiding means variance dependents, choosing noise performance measure, minute analysis and life testing Taguchi tolerance design and tolerance (re) design.

Unit-IV

Quality Information System: Scope of quality information system. Different between QIS and MIS. Creating new software (steps, types, defects) reports on quality (operational and executive reports) Features of QIS software. Software for inspection.

Inspection System: Operational sorting and correction sorting. AQL, LTPD, AOQL. Non destructive test. Audit systems: (quality improvement planning and implementation, describing quality function, process control system. Control of measurement system, material identification and control, drawing and specification control, process corrective action) the concept of POKAYOKE.

Unit-V

Measure of customer needs: The need to measure customer satisfaction. Importance of proper packaging, customer processing and installation of product, dealing with customer complaints, using weibull analysis, field feed back, parameter to measure customer (Dis) satisfaction. Problems with the customer satisfaction system. Beyond TOM: Difficulties in implementing TOM system, rating your quality system. JIT system, the people side of TOM. system integration, Kansei engineering and flexibility in manufacturing.

Suggested Reading:

1. H. G. Menon. *TOM in view Production Manufacturing,* Me Graw Hill, Publishers.
2. N. G. Logothetis, *Managing for total quality.*
3. J.M. Juran& Frank Gryna, *Quality planning and analysis.*

Course Code	Course Title						Core/Elective
PE 823 ME	COMPOSITE MATERIALS						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives: The objectives of this course are to:
- Discuss the basic structure of composites
- Define Elastic constants and Hygro-thermal stresses
- identify stress-strain relations in composites
- Describe the behaviour and Design with composites
- Demonstrate the basic equations of plate bending

Course Outcomes: On completion of the course the student will be able to:
- demonstrate knowledge of composites and their structure
- predict the Elastic constants and Hygrothermal stresses
- analyse the stress - strain relationship in composites
- summarise and apply the Design procedure and the failure criteria.
- formulatePlate bending equations for various Boundary conditions of composite plates.

UNIT-I

Introduction: Fibres, Matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composite, carbon fibre composites.

UNIT-II

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

UNIT-III

Macro-mechanics 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, inter-laminar stresses and edge effects. Simplified composite beam solutions. Bending of laminated beams.

UNIT-IV

Strength, fracture, fatigue and design:
Tensile and compressive strength of unidirectional fibre composites, fracture modes in composites: Single and multiple fracture, de-bonding, fibre pullout and de-lamination failure, fatigue of liminate composites, Effect of variability of fibre strength.
Strength of an orthotropic lamina: Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria. Designing with composite materials.

UNIT-V

Analysis of plates and stress:
Plate equilibrium equations, Bending of composite plates, Levy and Navier solution for plates of composite material. Analysis of composite cylindrical shells under axially symmetric loads.

Suggested Readings:

1. Jones, R.M., 'Mechanics of Composite Materials', Mc-Graw Hill Co., 1967.
2. Calcote, L.R., 'The Analysis of Laminated Composite Structures', Van Nostrand, 1969.

3. Whitney. I.M., Daniel, R.B. Pipes, 'Experimental Mechanics of Fibre Reinforced Composite Materials', Prentice Hall, 1984.
4. Hyer. M.W., 'Stress Analysis of Fibre-Reinforced Composite Materials', McGraw Hill Co., 1998.
5. Carl. T.Herakovich, 'Mechanics of Fibrous Composites', John Wiley Sons Inc., 1998.

Course Code	**Course Title**						**Core/Elective**
PE 824 ME	**NON-DESTRUCTIVE TESTING**						**Elective**
Prerequisite	**Contact Hours Per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives: Student has to understand the

- Need, basic concepts and technologies of Non Destructive Testing (NDT)
- Security precautions from Radiography, protection from radiation and measurement ofradiation received by personnel.
- Technology of acoustic emission (AE), the associated instrumentation and applications
- Technologies like neutron radiography; laser induced ultrasonics, surface analysis andthermography
- Merits and demerits of the different NDT Technologies
- Latest research and developments in NDT

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

- the knowledge of different NDT techniques.
- clear understanding of liquid penetrant inspection and magnetic particle inspection.
- view and interpret radiographs, utilize the various principles of radiography for differentcomponents of different shapes.
- the knowledge of acoustic emission for NDT and the instrumentation used for NDT.
- the ability to analyze and prepare a technical report.
- the knowledge of latest research, developments and trends in NDT.

UNIT-I

Liquid penetrate inspection: Principles of penetrate inspection, characteristics of a penetrate,water washable system, post emulsification system , solvent removable system, surfacepreparation and cleaning, penetrate application, development, advantages limitations, andapplications.Magnetic particle instruction: Principle, magnetization methods, continuous and residual methods, sensitivities, demagnetization, magnetic particles, applications advantages andlimitations.

UNIT-II

Eddy current testing: Principle, lift-off factor, and edge effect, skin effect, inspection frequency,coil arrangements, inspection probes, types of circuit, reference pieces, phase analysis, displaymethods and applications.

UNIT-III

Ultrasonic testing: Generation of ultra sound, characteristics of an ultrasonic beam, sound wavesat interfaces, sound attenuation, display systems, probe construction, type of display, inspectiontechniques, identification of defects, Immersion testing , sensitivity and calibration. Referencestandards. Surface condition, Applications.

UNIT-IV

Radiography: Principle and uses of radiography, limitation principle, radiation sources,production of X-Rays, x-ray spectra, attenuation of radiation, radiographic equivalence, shadowformation enlargement and distortion, radio graphic film and paper, Xeroradiography,fluoroscopy, exposure factors, radiographic screens, identification markers and image qualityindicators, inspection of simple shapes, inspection of complex shapes, viewing and interpretationof radiographs, radiation hazard, protection against radiation, measurement of radiation receivedby personnel.

UNIT-V

Acoustic Emission: Physical Principles, Sources of emission, instrumentation and applications,Other NDT Techniques: Neuron radiography, Laser induced ultrasonics, surface analysis, andthermography.

Suggested Readings:

1. Barry Hull & Vernon John, *Non Destructive Testing*, 1988.
2. H J Frissell (Editorial Coordinator), Non-*Destructive Evaluation and quality control*,ASM handbook-International Publication USA, 1989.
3. Dove and Adams, *Experimental Stress analysis and Motion Measurement*, Prentice Hallof India, Delhi

Suggested Reading:

1. *Non-Destructive Examination and Quality Control*, ASM International, Vol.17, 9thedition (1989)
2. J. Prasad and C. G. K. Nair, *Non-Destructive Test and Evaluation of Materials*, TataMcGraw-Hill Education, 2nd edition (2011).
3. B. Raj, T. Jayakumar and M. Thavasimuthu, Practical *Non Destructive Testing*, AlphaScience International Limited, 3 rd edition (2002).
4. T. Rangachari, J. Prasad and B.N.S. Murthy, *Treatise on non-destructive testing andevaluation*, Navbharath Enterprises, Vol.3, (1983).

Course Code	Course Title						Core / Elective
PE 831 MP	RAPID PROTOTYPING TECHNOLOGIES						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	3	30	70	3

Course Objectives

- To gain fundamental knowledge in understanding different techniques of prototyping.
- To study and understand the core prototyping
- .

Course Outcomes

At the end of the course

- Will be able to know the prototyping
- Will be able to understand 3-D printing and its applications
- Will be able to understand the advantages and disadvantages of prototyping and its impact on national and global economy

UNIT-I

Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages of Rapid Prototyping, Commonly used Terms, Rapid Prototyping Process Chain, 3D Modeling, Data conversion and Transmission, Checking and Preparing, Building,

Postprocesing, RP Data formats, Classification of RP process.

UNIT -II

Liquid-based Rapid Prototyping Systems: Stereolithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photopolymerization, 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.

UNIT -III

Solid-based Rapid Prototyping Systems: Laminated 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 -IV

Powder Based Rapid Prototyping 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.

UNIT -V

Applications ofRapid Prototyping Technology: Functional models, Pattern for investment and vacuum casting, Medical Models, Art Models, Engineering Analysis Models.

Suggested Reading:

1. Chua C.K., Leong K.F. and LIM C.S, *World Rapid prototyping:Principles and Applications,* Scientific Publications, Second edition, 2004.

2. D.T. PhamandS.S.Dimov, *Springer Rapid Manufacturing,* 2001

3. Terry Wohlers, *Wholers Report 2000,* Wohlers Associ*ates*, 2000.

Course Code	Course Title						Core/Elective
PE 822 ME	MECHANICAL VIBRATIONS						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives: Student has to understand the
- Explain the concept of vibrations, with single and multi-degree freedom
- Discuss the numerical methods involved in vibrations
- Demonstrate the concept of Transient vibrations and Random vibrations
- Identify various methods of vibration control.
- Describe the concept of Non-Linear vibrations Identify various methods of vibration control.

Course Outcomes: At the end of the course, the students will be able to
- analyse the multi degree of freedom systems vibrations
- formulate vibration problem using various numerical methods
- interpret the concept of the Random and Transient vibrations
- apply various methods for vibration control
- interpret the non-linear phenomenon of vibrations and their formulation

UNIT-I

Multi Degree Freedom System:-Free Vibration equation of motion. Influence Coefficient i)StiffnessCoeff. (ii) Flexibility Coeff. Generalized co ordinates, and Coordinate couplings. Langranges Equations Matrix Method Eigen Values Eigen Vector problems. Modal Analysis. Forced Vibrations of undamped system and modal analysis. Multi Degree System Numerical Methods:-(i)Rayleigh`s Method, (ii)Rayleigh-Ritz Method (iii)Holzer`s Method (iv)Methods of Matrix iterations (v) Transfer Matrix Method, Impulse response and frequency response functions.

UNIT-II

Continuous System:- Vibrations of String, Bars, Shafts and beams, free and forced vibration of continuous systems.

UNIT-III

Modal Parameter Extraction Methods Introduction – Preliminary checks of FRF Data – SDOF Modal Analysis-I – Peak-amplitude – SDOF Modal Analysis-II – Circle Fit Method – SDOF Modal Analysis III – Inverse Method – Residuals – MDOF curve-fitting procedures – MDOF curve fitting in the Time Domain – Global or Multi-Curve fitting – Non linear systems.

Unit-IV

Vibration Control:-Balancing of rotating machine, In-situ balancing of rotors, control of natural frequency introduction of damping, vibration isolation & vibration absorbers..Vibration Measurement:- FFT analyzer, vibration exciters, signal analysis. Time domain & Frequency domain analysis of signals. Experimental modal analysis, Machine Conditioning and Monitoring, fault diagnosis.

Unit-V

Random Vibrations:- Expected values auto and cross correlation function, Spectral density, response of linear systems, analysis of narrow band systems. Non Linear Vibrations:-Systems with non-linear elastic properties, free vibrations of system with non-linear elasticity and damping, phase-plane technique, Duffing’s equation, jump phenomenon, Limit cycle, perturbation method.

Suggested Readings:

1. W T Thomson., “ Theory of Vibrations with Applications”, CBS Publishers
2. S S Rao, “ Mechanical Vibrations”, Addison-Wesley Publishing Co.

3. Leonard Meirovitch, " Fundamentals of Vibration", McGraw Hill International Edison.
4. J P Den Hartog, "Mechanical Vibrations", McGraw Hill.
5. Srinivasan, " Mechanical Vibration Analysis", McGraw Hill.
6. Nuno Manuel Mendes Maia et al," Theoretical and Experimental Modal Analysis", Wiley John & sons, 1999

Course Code	Course Title						Core/Elective
PE 832 ME	ROBOTIC ENGINEERING						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives: Students will understand
- The configuration, work envelop and motion controls and applications
- Familiarities with the kinematics of robots.
- Robot end effectors and their design.
- Familiarities with the dynamics of robots.
- Robot Programming methods & Languages of robot.
- Various Sensors and drives and their applications in robots

Course Outcomes: At the end of the course, the students will be
- Equipped with robot anatomy, work volume and robot applications
- Familiarized with the kinematic motions of robot
- Having good knowledge about robot end effectors and their design concepts
- Familiarized with the robot dynamics
- Equipped with the Programming methods & drives used in robots
- Equipped with the principles of various Sensors and their applications in robots.

UNIT-I

Robots: History and evolution of robots, Laws of Robotics, basic configuration, degree offreedom, work envelope, motion control methods, Application in industry, material handling,loading & unloading, processing, welding & painting applications, assembly and inspection,Robot specification requirements

UNIT-II

Rotation matrix: Homogenous transformation matrix, Denavit-Hartenberg convention, Eulerangles, RPY reprensation, Direct and inverse kinematics for industrial robots for position andorientation, Redundancy

UNIT-III

Manipulator Jacobian: Joint, End effector velocity, direct and inverse velocity nalysis,Trajectory Planning, interpolation, cubic polynomial, linear segments with with parabolicblending, static force and moment transformation, solvability, stiffness, singularities

UNIT-IV

Robot dynamics: Lagrangian formulation, link inertia tensor and manipulator inertia tensor,Newton-Euler formulation for RR & RP manipulators, Control: Individual joint, computedtorque

UNIT-V

End effectors: position and velocity measurement, Sensors: Proximity and range, tactile, forceand torque, Drives for Robots: Electrical, Hydraulic and Pneumatic, Robot vision: Introductionto technique, image acquisition and processing, introduction to robot programming languages.

Suggested Reading:

1. Spong and Vidyasagar, *Robot Dynamics and Control*, John Wile and Sons, 1990
2. R.K. Mittal, I.J. Nagrath, *Robotics and control*, Tata Mcgraw-Hill PublishingCompany Ltd. 2003
3. Groover, *Industrial Robotics*, Mcgraw-Hill Publishing Company Ltd. 2003
4. Asada and Siotine, *Robot analysis and Intelligence*, Wiley Interscience, 1986

5. K.S. Fu GonZalezRC., lEEc.S.G., *Robotics, Control Sensing Vision and Intelligence*,McGraw Hill, Int. Ed., 1987
6.Richard S. Paul, *Robot Manipulators: Mathematics, Programming, and Control*, MITPress (MA)

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core/Elective</th></tr>
<tr><td>PE 834 ME</td><td colspan="6">PRODUCT DESIGN AND PROCESS PLANNING</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours Per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>-</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives:

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

- Identify the functions of design of a product in a system in a given situation and select a suitable product ; identify the procedure for technological innovation of a product; explain the importance of brainstorming and Delphi techniques in innovation
- Explain the importance of design, human machine interaction in project selection and evaluation methods including ergonomic considerations
- Explain the importance of research in new product development; describe the process of patenting including search of patents, patent laws and international code and discriminate the scope of IPR for a product patent.
- Discuss the features of design of a new product with respect to manufacture, quality testing and marketing; and steps to evaluate a new product for introduction;
- Develop process planning including creating process sheets; explain value engineering, group technology and concurrent engineering in the selection of manufacturing process.

UNIT-I

Product Design and Process Design functions. Selection of right product. Systematic procedure of product innovation. Factors contributing to successful technological innovation - need for creativity and innovation. Techniques of innovation like brain storming and Delphi techniques.

UNIT-II

Project Selection and Evaluation: Function of design - Design withHuman Machine Interaction (HMI). Collection of ideas and purpose of project. Selection criteria - screening ideas for new products using evaluation techniques. Principles of ergonomics.

UNIT-Ill

New Product Development: Research and new product development.Patents, definitions, patent search, patent laws, international code for patents -Intellectual Property Rights (IPR).

UNIT-IV

New **Product Planning** : Interaction between the functions of design, manufacture, quality, testing and marketing. Steps for introducing new products after evaluation.

UNIT-V

Process Planning : Process planning, process sheets, selection of manufacturing process, estimation of machining time in various cutting operations - estimation of costs for manufacture. Value engineering in product design, group technology, concepts of concurrent engineering.

Suggested Reading:

1.Niebel BW & Draper AB: *Production Design & Process Engg,*McGraw Hill, Kogakusha, 1974.
2.Harry Nystrom, *Creativity and Innovation,* John Wiley & Sons,
3.BrainTwiss, *Managing Technological Innovation,*Pittrnan Publications, 1992.
4.Harry, B.Waton, *New Product Planning,* Prentice Hall Inc., 1992.
5.Chitale, A. K. & Gupta RC., *Product Design & Manufacturing,*PHI, 1997.

Course Code	Course Title						Core/Elective
PE 843 ME	MACHINE TOOL ENGINEERING AND DESIGN						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives: Students will understand
- Types of tools for heavy machining processes
- Design elements in sheet metal operation
- Use of jigs and fixtures for automation in industries

Course Outcomes: At the end of the course, the students will be able to
- Understand basic motions involved in a machine tool.
- Design machine tool structures
- Design and analyze systems for specified speeds and feeds
- Understand control strategies for machine tool operations
- Apply appropriate quality tests for quality assurance

UNIT-I

Classification of Machine Tools: General purpose, Special purpose, Automatic, Semi-Automatic machine tools, Transfer lines. Kinematics of Machine Tools: Shaping of geometrical and real surfaces, Developing and designing of kinematics schemes of machine tools, Kinematic structures of lathe, drilling, milling, relieving lathe, grinding, gear shaping and gear hobbing machining. Kinematic design and speed and feed boxes. Productivity loss. Stepped and stepless regulation.

UNIT-II

Strength and Rigidity of Machine Tool Structures: Basic principles of design for strength. Different types of structures. General design procedures. Effect of materials and shape factors on the rigidity of structure, overall compliance of machine tool. Design of beds, bases columns, tables, cross rails for various machines. Effect of wear of guide ways on the performance. Various types of guide ways, their relative advantages. Materials for machine tool components including plastic guide ways (PTFE).

UNIT-III

Analysis of Spindles, Bearing and Power Screws: Design of spindles subjected to combined bending and torsion. Layout of bearings. Pre-loading. Anti-friction slide ways. Rolling contact, hydrodynamic, hydrostatic, aerostatics and magnetic bearings, their relative performance. Power Screws, Recirculating ball screws. Hydrodynamic design of journal bearings.

UNIT-IV

Machine Tool Vibrations: Effect of vibration on machine tool; Forced vibrations. Machine tool chatter. Self excited vibration and dynamic stability single and two degree freedom analysis. Comply coefficient. Elimination of vibration. Vibration analysis of machine tool structures.

UNIT-V

Hydraulic Systems: General principles, hydraulic fluid power lines. Properties of hydraulic fluid. Various positive displacement pumps, their characteristics and operation. Design of hydraulic tanks and other systems. Various valves used in hydraulic systems. Design and application of various hydraulic circuits. One position and multi-position scheme. Single and multi pump screws. Electrical analogy. Pneumatic circuits. Hydro copying system. Evaluation of machine tools with regard to accuracies, sound and vibration. Machine tool testing.

Suggested Reading:

1. Sen and Bhattacharya, Principles of Machine Tools, New Central Book Agency, Calcutta, 1975.
2. S.K. Basu, Design of Machine Tools, Allied Publishers, India, 1961.
3. Acharkan, Machine Tool Design(vol. 1,2 & 3), MIR Publishers, Moscow, 1973.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core/Elective</th></tr>
<tr><td>PE 842 MP</td><td colspan="6">PLASTIC ENGINEERING AND TECHNOLOGY</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours Per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>-</td><td>3</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives:
- To learn the basics of plastics and processing methods used in plastic manufacturing
- To gain knowledge about injection moulding, polymers and thermoplastics

Course Outcomes: At the end of the course, the students will be able to
- Analyse the plastic material properties
- Industrial applications and manufacturing methods

UNIT -I

General properties of plastics: Polymeric Materials, Plastics available to the designer, Engineering Plastics, Thermosets, composites, structural foam, Polymer alloy, selection of plastics, Mechanical properties, Impact Enhancement, Degradation, wear resistance and frictional properties, specialproperties processing, costs -selection for strength at minimum cost.

UNIT II

Mechanical properties of plastics -Deformation, Viscoelastic behaviour of plastics, short term testing of plastics, long term testing of plastics, Design methods of plastic using deformation data, Mathematical models of viscoelastic behaviour, Intermittent loading, Deformation behaviour of reinforced plastics.

UNIT -Ill

Mechanical properties of plastics -Fracture. The concept of stress concentration, Energy approach to fracture, Stress Intensity Factor approach to fracture, J-integral approach, General fracture behaviour of plastics, creep failure of plastics. Fatigue of plastics, Impact behaviour of plastics.

UNIT -IV

Processing of plastics. Extrusion -Mechanism of flow, analysis of flow in extruder, Extruder volumetric efficiency, power requirements. Injection Moulding: Moulds, CAD of moulds, structural foam Injection moulding, Reaction injection moulding, Injection blow moulding, injection moulding of thermosets. Thermoforming, calendering, Rotation moulding, compression moulding, transfer molding, automatic processes, die design of plastics, Joining process -Hot air, ultrasonic, and solvent welding.

Unit-V

Analysis of polymer melt flow. General behaviour of polymers melts, Isothermal flow of polymers Melts, Residence and Relaxation times, Experimental Methods used to obtain flow data.

Suggested Reading:

1. Plastics and Rubber, *Engineering Design and Application,* R.J. Crawford.

2. N.A. Waterman, *The selection and use of Engineering Materials.*

3. Rossi, *WeldingEngineering*, McGrawHill.

Course Code	Course Title						Core/Elective
PE 841 ME	INTELLECTUAL PROPERTY RIGHTS						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives: Students will understand
- Fundamental aspects of IP
- Aspects of IPR acts.
- Awareness of multi disciplinary audience
- Awareness for innovation and its importance
- The changes in IPR culture
- About techno-business aspects of IPR

Course Outcomes: At the end of the course, the students will be able to
- Will respect intellectual property of others
- Learn the art of understanding IPR
- Develop the capability of searching the stage of innovations.
- Capable of filing a patent document independently.
- Completely understand the techno-legal business angle of IP. .
- Capable of converting creativity into IP and effectively protect it.

UNIT-I

Overview of Intellectual Property: Introduction and the need for intellectual property right(IPR), IPR in India – Genesis and Development, IPR abroad, Some important examples of IPR.Importance of WTO, TRIPS agreement, International Conventions and PCT

Patents: Macro economic impact of the patent system, Patent and kind of inventions protectedby a patent, Patent document, How to protect your inventions. Granting of patent, Rights of apatent, how extensive is patent protection. Why protect inventions by patents. Searching a patent,Drafting of a patent, Filing of a patent, the different layers of the international patent system,(national, regional and international options), compulsory licensing and licensers of right & revocation, Utility models, Differences between a utility model and a patent. Trade secrets andknow-how agreements

UNIT-II

Industrial Designs: What is an industrial design. How can industrial designs be protected? Whatkind of protection is provided by industrial designs? How long does the protection last? Whyprotect industrial designs?

UNIT-III

Trademarks: What is a trademark, Rights of trademark? What kind of signs can be used astrademarks. Types of trademark, function does a trademark perform, How is a trademarkprotected? How is a trademark registered. How long is a registered trademark protected for?How extensive is trademark protection. What are well-known marks and how are they protected?Domain name and how does it relate to trademarks? Trademark infringement and passing off.

UNIT-IV

Copyright: What is copyright. What is covered by copyright. How long does copyright last?Why protect copyright? Related Rights: what are related rights. Distinction between related rights and copyright. Rights covered by copyright? Copy rights in computer programming.

UNIT-V

Enforcement of Intellectual Property Rights: Infringement of intellectual property rightsEnforcement Measures Emerging issues in Intellectual property protection. Case studies ofpatents and IP Protection.
Unfair Competition: What is unfair competition. Relationship between unfair competition andintellectual property laws.

Suggested Reading:

1. AjitParulekar and Sarita D' Souza, *Indian Patents Law – Legal & Business Implications*;Macmillan India ltd , 2006
2. B. L.Wadehra; *Law Relating to Patents, Trade Marks*, *Copyright*, *Designs &Geographical Indications*; Universal law Publishing Pvt. Ltd., India 2000
3. P. Narayanan*; Law of Copyright and Industrial Designs*; Eastern law House, Delhi 2010
4. Cronish W.R1 *Intellectual Property; Patents, copyright, Trad and Allied rights*, Sweet &Maxwell, 1993.
5. P. Narayanan, *Intellectual Property Law*, Eastern Law Edn., 1997.
6. Robin Jacob and Daniel Alexander, *A Guide Book to Intellectual Property Patents,Trademarks, Copy rights and designs*, Sweet, Maxwell 4th Edition.

Course Code	Course Title						Core/Elective
PE 844 ME	ENTREPRENEURSHIP DEVELOPMENT						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives:

Course Outcomes:

- Understand Indian IndustriaI Environment, Entrepreneurship and Economic growth, Small and Large scale Industries, Types and forms of enterprises.
- Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
- Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
- Apply the concepts of Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques
- Understand the Behavioral aspects of entrepreneurs, Time Management, Various approaches of time management, their strengths and weakness. The urgency addiction and time management matrix.

UNIT-I

Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.

UNIT-II

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

UNIT-III

Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis, project financing in India.

UNIT-IV

Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of tax burden.

UNIT-V

Behavioural aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

Suggested Readings:

1.Vasant Desai, *"Dynamics of Entrepreneurial Development andManagement",* Himalaya Publishing House, 1997.
2.Prasanna Chandra, *"Project-Planning, Analysis, Selection,Implementation and Review",* Tata Mcgraw-Hill Publishing CompanyLtd. 1995.
3.Stephen R. Covey and A. Roger Merrill, *"First Things First",* Simon and Schuster Publication, 1994.
4.G.S. Sudha, *"Organizational Behaviuor",* 1996.

5.Robert D. Hisrich, Michael P. Peters, *"Entrepreneurship",* Tata Me Graw Hill Publishing Company Ltd., 5^{lh} Ed., 2005.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core/Elective</th></tr>
<tr><td>PC 851 ME</td><td colspan="6">SEMINAR</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours Per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>2</td><td>25</td><td>50</td><td>1</td></tr>
<tr><td colspan="8">Course Objectives:</td></tr>
</table>

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of state of the art topics in a broad area of *hisI*her specialization.

Seminar*topics*may he chosen by thestudentSwith advice from the faculty members. Students are to be exposed to following aspects of seminar presentations.

Literature surveyOrganisationof material

Preparation of OH!' slides*I*PC presentation Technical writing.

Eachstudent will be required to

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Give a 20 minutes presentation through OHP,PC. Slide projector followed by 10 minutes discussion.
3. Submit a report on the seminar topic with list of references and slides used.

Seminars are to be scheduled from the 3 week to the last week of the semester and any change in schedule should be discouraged.

TheSessionalsmarks will be awarded to the students by at least 2 faculty members on the basis of an average of written presentation as well as their involvement in the discussions.

Course Code	Course Title						Core/Elective
PC 852 ME	PROJECT						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1
Course Objectives:							

Solving a real life problem should be the focus of U.G. project. Faculty members should prepare project briefs well in advance. They should be made available to the students at the Department Library. A project may be classified as hardware / software / modeling / simulation. It should involve elements such as analysis, design and synthesis.

The Department will appoint a project coordinator who will be in-charge of the following

- Grouping of students (Maximum of three in a group).
- Allotment of projects and project guide.
- Project monitoring at regular intervals.

A project allotment is to be completed by the 4^{th} week of 1^{s1} semester of IV year so that students get sufficient time for completion of their project.

All the projects are to be checked for progress at least twice in a semester. It should be on the basis of presentation of the students.

Sessionals marks to be based on the Grade / Marks awarded by a monitoring committee comprising of faculty members as well as by the supervisor.

Efforts to be made so that some of the projects are carried out in industries. Projects may also be invited from industries.

Norms of final documentation of the project report are to be provided by the Department.

**** Excellent / Very Good / Good / Satisfactory / Unsatisfactory.***

Note : Three periods of contact load will be assigned to each projectguide.

FACULTY OF ENGINEERING

Scheme of Instruction & Examination

(CBCS Curriculum for the Academic Year 2019-2020)

and

Syllabi

B.E. VII and VIII Semester

of

Four Year Degree Programme

In

Automobile Engineering

(With effect from the academic year 2019– 2020)

(As approved in the faculty meeting held on 25-06-2019)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad – 500 007

2019

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VII - Semester
(AUTOMOBILE ENGINEERING)

S.No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Dg	Contact Hrs / wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	PC701AE	Automotive Air Conditioning	4			4	30	70	3	4
2	PC702AE	Vehicle Maintenance	4			4	30	70	3	4
3	PC703AE	Metrology & Automobile Instrumentation	3			3	30	70	3	3
4	PC704AE	Vehicle Body Engineering	4	-	-	4	30	70	3	4
5	HS401CM	Managerial Economics & Accountancy	3	-	-	3	30	70	3	3
6	OE -II	Open Elective-II	3			3	30	70	3	3
Practical / Laboratory Courses										
7	PC 751AE	Reconditioning Lab			2	2	25	50	3	1
8	PC752AE	Metrology & Automobile Instrumentation Lab			2	2	25	50	3	1
9	PC753AE	Project Seminar			2	2	25	-	3	1
		Total	**21**	**-**	**6**	**27**	**255**	**520**	**-**	**24**

Open Elective- II	
Course Code	Course Title 1
OE721AE	Automotive Vehicle Maintenance

BS: Basic Sciences ES: Engineering Sciences MC: Mandatory Course
PC: Professional Course HS: Humanities and Sciences
L: Lectures T: Tutorials Pr : Practicals Drg: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour
2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PC701AE</td><td colspan="6">Automotive Air-Conditioning</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact hours per week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>NIL</td><td>4</td><td>--</td><td>--</td><td>--</td><td>30</td><td>70</td><td>4</td></tr>
</table>

Course Objectives:

- To have the knowledge on psychrometry, application of basics of thermodynamics and psychrometric chart.
- To understand the terminology related to air conditioning load calculations and design considerations for summer and winter air conditioning system.
- To know the different air conditioning system components along with their controllers and regulators
- To understand the different refrigerants along with their properties and ford automatically controlled air conditioner and heater system.
- To understand the duct system for controlling flow, automotive air conditioning maintenance, service and trouble shooting.

Course Outcomes:

The student is able to

- Explain psychrometric processes using Psychrometric chart
- Perform the load calculations for the given conditions
- Demonstrate the working principle of the components of air-conditioning systems
- Select the suitable refrigerant by analyzing its properties
- Design the duct system and maintain automobile air-conditioning.

Unit I

Psychrometry: Psychrometric properties, Psychrometric chart, construction, Representation of Psychrometric processes on the chart, Heat and Cooling with Humidification and Dehumidification, Adiabatic dehumidification, Adiabatic chemical dehumidification and mixing processes.

UNIT II

Cooling Load Calculations in Air Conditioning: Concept of bypass factor, Sensible beat factor, Apparatus Dew Point, Room Sensible Heat Factor (RSHF), Gross Sensible Heat Factor (GSHF), Different heating and cooling loads, Problems.

Design Of Air Conditioning Systems: All fresh air, Re-circulated air with bypassed air, Design of Summer, Winter and Year round air conditioning systems

UNIT III

Air-Conditioning Components: Basic air conditioning system, Location of air conditioning components in a car, schematic layout of a refrigeration system. Compressor components, Condenser and high pressure service ports. Thermostatic expansion valve, Expansion valve calibration, Controlling evaporator temperature, evaporator pressure regulator, evaporator temperature regulator.

UNIT IV

Refrigerants: Classification of refrigerants, coding of Refrigerants, desirable properties of refrigerants, substitute for CFC refrigerants, containers, handling refrigerants, tapping into the refrigerant container. Ambient conditions affecting system pressures.

Heating System and Temperature Control: Automotive heaters - Manually controlled air conditioner - Heater system - Ford automatically controlled air conditioner and heater systems - Automatic temperature control - Air conditioning protection.

UNIT V

Air Routing

Objectives - Evaporator care air, flow through the Dash recirculating unit - Duct system - Controlling flow.

Air Conditioning Service

Air conditioner maintenance and service - Servicing heater system - Trouble shooting of air controlling system - Compressor service.

Suggested Reading:

1. William H Crouse and Donald L Anglin, "Automotive Air conditioning ", McGraw-Hill Inc., 1990.
2. Mitchell information Services, Inc, "Mitchell Automatic Heating and Air Conditioning Systems ", Prentice Hall Ind., 1989.
3. Paul Weiser, “Automotive Air Conditioning ", Reston Publishing Co Inc., 1990.
4. MacDonald, K.L., "Automotive Air Conditioning ", Theodore Audel series, 1978. Goings. L.F., Automotive Air Conditioning ", American Technical services, 1974.

Course Code	Course Title						Core / Elective
PC702AE	Vehicle Maintenance						Core
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Automotive Chassis and Components	**4**	--	--	--	**30**	**70**	**4**

Course Objectives

- To study basic types of vehicle maintenance along with its importance.
- To understand the trouble diagnosis procedure for electrical and electronic systems in automobiles
- To know the dismantling and service procedure of drive line system
- To acquaint with various Trouble shooting, fault tracing practices available in automobile industry.
- To understand the maintenance procedure for air-conditioning in automobiles.

Course Outcomes

The student is able to

- Demonstrate the maintenance procedure for automotive Engine and prepare checklist
- Illustrate the trouble diagnosis procedure for electrical systems like Battery, Starting Systems
- Identify the trouble diagnosis procedure for steering and suspension system.
- Illustrate trouble diagnosis procedure for lubrication and fuel delivery system etc.
- Explain trouble diagnosis procedure for heating system of automobile.

UNIT I

Maintenance, Workshop Practices, Safety and Tools: Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations – workshop manual - vehicle identification. Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools – special service tools – measuring instruments – condition checking of seals, gaskets and sealants. Scheduled maintenance services – service intervals - Towing and recovering.

UNIT II

Engine And Engine Subsystem Maintenance: General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management. Service - fault diagnosis- servicing emission controls.

UNIT III

Transmission and Driveline Maintenance: Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission,- road testing- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

UNIT IV

Steering, Brake, Suspension and Wheel Maintenance: Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, Parking brake. Bleeding of brakes. Inspection, Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steering linkage, steering column, Rack and pinion steering, Recirculating ball steering service- Worm type steering, power steering system.

UNIT V

Auto Electrical And Air Conditioing Maintenance: Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection- AC Charging- Fault diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

Suggested Reading:

1. Ed May, "Automotive Mechanics Volume One" ,McGraw Hill Publications, 2003
2. Ed May, "Automotive Mechanics Volume Two" ,McGraw Hill Publications, 2003
3. Vehicle Service Manuals of reputed manufacturers

REFERENCES:

1. Bosch Automotive Handbook, Sixth Edition, 2004

Course Code	Course Title						Core / Elective
PC703AE	Metrology & Automobile Instrumentation						Core
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	--	--	--	**30**	**70**	**3**

Course Objectives:

- To understand limits, fits and tolerances and their applications. Linear and angular measurements and measuring instruments.
- To understand the design of limit gauges, evaluate roughness and its measurement.
- To understand basic measuring system, static and dynamic characteristics of instruments.
- To understand various principles to measure pressure, temperature, displacement, force, torque and vibrations.
- To understand seismic transducers and various gauges

Course Outcomes:
The students will be able to

- Determine Limits & fits, I.S.O. system and the instruments used to measure these limits.
- Accurate measurement of precision linear and angular measuring instruments.
- Identify and measure form errors.
- Demonstrate working principles of various instruments used for the measurement of strain, forces, pressure, temperature and vibrations.
- Use seismic transducers and different gauges

UNIT-I:
Limits and Fits, ISO system: Types of interchangeability Taylor's Principle or plain limit gauges, Use of Plug, Ring and Snap gauges. Indicating type limit gauges. Introduction_ Linear and Angular measurements – Slip gauges and End bars – Gauge material and manufacturing methods, Different types of Micrometers, Height gauges Tomlinson gauges. Precision polygon, Sine bar, Auto collimator

UNIT-II:
Comparators: Dial indicator, Sigma and Mechanical comparator, free flow and back pressure type Pneumatic comparator. Application of set jet gauge heads. Optical projector, Chart, screen gauges and measuring methods, Micro Gauge Bridge lines Tool maker's Microscope applications. Measurement of Straightness and Flatness Roundness measurement with bench centers and talyrond, Coordinate Measuring Machine in complex geometries

UNIT-III:
Surface Roughness Measurements –parameters as per ISO indices. Profilometer, Taylor HobsonTalysurf. Application of Thread metrology - 2 wire and 3 wire methods, Gear measurement - Gear tooth thickness, Parkinson gear tester, General geometric tests for testing machine tools – Lathe, drill and Mill.

UNIT-IV:

Elements of Instrumentation System- Static and Dynamic characteristics, Types of errors. Displacement transducers LVDT Strain measurement -Wire and foil type resistance strain gauges. Rosette Gauges. Bonding procedure Lead resistance compensation. Adjacent arm and self-compensating gauges proving ring Strain gauge load cells, measurement of axial load and torsion by strain gauges. Piezo-electric load cell

UNIT-V:

Introduction to Seismic Transducers -displacement and acceleration measurement, Pressure measurement -Bourdon pressure gauge, bulk modulus gauge, Pirani gauge, Temperature measurement by thermo couples. Laws of thermo electricity Types of materials used in thermocouples Protection tubes. Extension wire Series and parallel circuit’s ambient temperature compensation.

Suggested Reading:

1. I.C. Gupta – “Engineering metrology”, Dhanpat Rai Publications, New Delhi.
2. RegaRajendra, “Principles of Engineering Metrology”, Jaico Publishing House, Mumbai.
3. RK Jain, "Engineering Metrology", Khanna Publications, 1996.
4. Doeblin,"Measurement Systems Application and Design”, Tata Mc¬Graw Hill,5th ed., 2004.
5. Beckwith, Buck, Lienhard, Mechanical Measurements, Paerson education india
6. P. Donald Echman, "Industrial Instrumentation", John Wiley and Sons, 1996.
7. Hume, "Engineering Metrology", Kalyani Publications, 1985.

Course Code	Course Title						Core / Elective
PC704AE	Vehicle Body Engineering						Core
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
NIL	**4**	--	--	--	**30**	**70**	**4**

Course Objectives:

- To identify all types of cars body details. Apply knowledge to identify different vehicles dimensions and engine location
- Explain the importance of aerodynamic effort, Apply the methods of reducing air resistance and wind tunnel testing
- To understand Load Distribution, Body design requirement and car body space nomenclature.
- To know Interior ergonomics and vehicle body safety
- To understand Noise and vibration, explain the types of materials used in automobiles, and Explain paint and painting process

Course Outcomes:

On completion of the course the student must be able to

- Identify all types of cars body details and to identify different vehicles dimensions and engine location
- The importance of aerodynamic effort , Apply the methods of reducing air resistance and wind tunnel testing
- Load Distribution, Body design requirement and car body space nomenclature.
- To know Interior ergonomics and vehicle body safety
- Noise and vibration in vehicle body, explain the types of materials used in automobiles, Apply skills for selection of materials for different components of automobile and explain paint and painting process

Unit - I

Car Body Details: Saloon car, Hatch back car, convertible, racing car and sports car. Bus body details: Single Decker, Mini bus, Bus body layout. Floor height, Engine location, Entrance and exit position Seat and other commercial vehicle dimension

Unit - II

Aerodynamic Effect: Pressure distribution on vehicle surface. Air resistance on vehicle, Wind tunnel testing. Flow visualization around vehicle. Methods of reducing air resistance. Effect of side force andwind thrust.

UNIT - III

Load Distribution: Types of load carrying structures -closed, integral, open, flat types. Calculation of loading cases- static, asymmetric, vertical loads. Load distribution, stress analysis of structure, body shell analysis.

Body: Body design requirement, car body space nomenclature. Body frame of passenger car and commercial vehicle. Different type of car door and window regulator, car roof, wind shield,

UNIT - IV

Interior Ergonomics: Introduction, seating dimensions, interior ergonomics, seat comfort, driver seat design, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, goods vehicle layout. Visibility, regulations, driver's visibility, methods of improving visibility.

Safety: Impact protection basics, physics of impact between deformable bodies, design for crash worthiness, occupant and cargo restraint, passive restraint systems, side impact analysis, bumper system.

UNIT – V

Noise and Vibration: Noise characteristics, sources of noise, noise level measurement techniques, body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression.

Body Materials : Different types of ferrous and non-ferrous materials used in vehicle such as cast iron. Steel. Alloy steel, plastic, G.R.P Glass etc. and their properties

Painting: Corrosion and anticorrosion method ,Paint and painting process

Suggested Reading:

1. Crouse W and Anglin D, Automotive Mechanics Tata McgrawHill, 10th edition, 2004
2. Jack E Rjavee, Automotive Technology- A system approach, Thomson Asia Pte Ltd,Singapore, 3rd edition, 2004
3. K Sing, Automobile Engineering Vol-I Standard Publishers Distributor 2003
4. Body Engineering -Sydney F Page
5. Vehicle Body Engineering -Gilcs J Pawlowski,
6. Automotive Chassis -P.M. Heldt. Chilton & Co.

Course Code	Course Title						Core / Elective
HS401CM	Managerial Economics & Accountancy						Core
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	--	--	--	**30**	**70**	**3**

Course Objectives:

- To learn important concepts of Managerial Economics and apply them to evaluate business decisions.
- To understand various parameters that determines the consumer's behavior.
- To evaluate the factors that affect production.
- To understand the concepts of capital budgeting and payback period.
- To study the concepts of various book-keeping methods.

Course Outcomes:

- Determine the objectives, nature, scope, role & responsibilities of a manager of a business undertaking.
- Predict the demand for a product or product mix of a company & to analyze various factors influencing demand elasticity.
- Forecast & compute the future sales level of a product by using various quantitative & qualitative techniques and with the help of past sales data.
- Discuss the process & principles of accounting and prepare Journal, Ledger, Trail Balance, Manufacturing A/c, Trading A/c., Profit & Loss A/c. and Balance Sheet of an enterprise.

UNIT-I:

Meaning and Nature of Managerial Economics: Managerial Economics and its usefulness to Engineers, Fundamental Concepts of Managerial Economics-Scarcity, Marginalism, Equimarginalism, Opportunity costs, Discounting, Time Perspective, Risk and Uncertainty, Profits, Case study method.

UNIT-II:

Consumer Behavior: Law of Demand, Determinants, Types of Demand; Elasticity of Demand (Price, Income and Cross-Elasticity); Demand Forecasting, Law of supply and Concept of Equilibrium. (Theory questions and small numerical problem can be asked)

UNIT-III:

Theory of Production and Markets: Production function, law of variable Proportion, ISO quants, Economics of Scale, Cost of Production (Types and their measurement), Concept of Opportunity Cost, Concept of Revenue, Cost-Output relationship, Break-even Analysis, Price – Output determination under Perfect Competition and Monopoly (theory and problems can be asked)

UNIT-IV:
Capital Management: Significance, determination and estimation of fixed and working capital requirements, sources of capital, Introduction to capital budgeting, methods of payback and discounted cash flow methods with problems. (Theory questions and numerical problems on estimating working capital budgeting opportunities can be asked)

UNIT-V:
Book-keeping: Principles and significance of double entry book keeping, Journal Subsidiary books, Ledger accounts, Trail Balance, concept and preparation of Final Accounts with simple adjustments, Analysis and interpretation of Financial Statements through Ratios.
(Theory questions and numerical problems on preparation of final accounts, cash book, petty cash book, bank reconciliation statement, calculation of some ratios)

Suggested Reading:

1. Mehta P.L., **Managerial Economics – Analysis, Problems and Cases,** Sulthan Chand & Sons Educational Publishers, 2011.
2. Maheshwari S.N**., Introduction to Accountancy**, Vikas Publishing House, 2005.
3. Pandey I.M., **Financial Management,** Vikas Publishing House, 2009.

Course Code	Course Title						Core / Elective
PC751AE	Reconditioning Lab						Core
	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
	--	--	--	2	25	50	1

Course Objectives:

- To understand the concept of cylinder reboring and study its parameters
- To understand the working of leaf spring
- To understand the flip and its calibration
- To study the concept of wheel alignment and related concept like caster camber , king pin inclination and toe in toe out
- To know how to check the off set of chassis frame
- To learn the concept of brake bleeding
- To know the concept of wheel balancing
- To understand valves working and of its parameters

List of Experiments:

1. Measurement of cylinder bore parameters.
2. Cylinder Re-boring
3. Cylinder honing
4. Valve grinding, valve lapping.
5. Calibration of fuel injection pump.
6. Wheel alignment-Testing of camber, caster, kingpin inclination, toe-in and toe out.
7. Chassis alignment testing
8. Break adjustment
9. Break bleeding
10. Wheel Balancing
11. Measurement of valve parameters
12. Fuel Injector Testing

Note: Minimum ten experiments should be conducted in the semester

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core / Elective</th></tr>
<tr><td rowspan="4">PC752AE</td><td colspan="6">Metrology & Automobile Instrumentation Lab</td><td>Core</td></tr>
<tr><td colspan="4">Contact hours per week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>2</td><td>25</td><td>50</td><td>1</td></tr>
</table>

Course Objectives:
To have knowledge of various precision measuring instruments.

Course Outcomes:

- Select and apply the knowledge of measuring tools for external, internal and angular measurements for promoting the qualitative production management.
- Adopt the principles of optical measurements in measurement of screw and gear profiles.
- Choose and practice the appropriate methods of force measuring devices principles for required situation.
- Demonstrate the need of machine alignment test for qualitative production.
- Practice calibration principles for maintaining the required precision of instruments / tools.
- Select and practice the methods of temperature measurement.
- Select cutting tool materials and tool geometries along with appropriate cutting conditions for different work materials and grind the cutting tools to the required geometry.

LIST OF EXPERIMENTS

Metrology and Automobile Instrumentation Lab:

1. Measurement with inside, outside and depth micrometers.
2. Measurement with height gauges, height masters, etc.
3. Measurement of Linear and Angular dimensions with Tool Makers Microscope – Flat specimens, plain, cylindrical specimens with centers and threaded components.
4. Measurement with - Dial Indicator / Electrical Comparator / Mechanical Comparator / Dial
5. Bore Gauges, etc.
6. Measurement of angles with Sine Bar, Bevel protractor and Precision level, Block level, etc.
7. Measurement of roundness errors with bench centres.
8. Geometrical tests on Lathe machine.
9. Measurement of flatness errors (surface plate) with precision level.
10. Measurement with optical projector.
11. Checking machined components with plug gauges, adjustable snap gauges, indicating gauges, etc.
12. Force measurement with strain gauge type load cell / proving ring / piezoelectric load cell etc. Temperature measurement with thermocouples.

Note: Minimum ten experiments should be conducted in the semester

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core / Elective</th></tr>
<tr><td rowspan="4">PC753AE</td><td colspan="6">Project Seminar</td><td>Core</td></tr>
<tr><td colspan="4">Contact hours per week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>--</td><td>25</td><td>--</td><td>1</td></tr>
</table>

The objective of the project seminar is to actively involve the student in the initial work required to undertake the final year project. It may comprise of:

- Problem definition and specifications.
- A broad understanding of the available techniques to solve a problem of interest.
- Presentation (Oral and Written) of the project.

The Department can initiate the work related to project allotment at the end of III year II semester and complete it in the first two weeks of the fourth year I semester.

First 4 weeks of IV year 1st semester will be spent on special lectures by faculty members, research scholar speakers from industries and R&D institutions. The objective of these talks is to be expose students to real like *I* practical problems and methodologies to solve them.

A seminar schedule will be prepared by the coordinator for all the students. It should be from the 5th week to the last week of the semester and should be strictly adhered to.
Each student will be required to

1. Submit a one page synopsis of the seminar to be delivered 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.

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 of contact load will be assigned to each project

SCHEME OF INSTRUCTION & EXAMINATION

B.E. VIII - Semester
(AUTOMOBILE ENGINEERING)

S.No.	Course Code	Course Title	Scheme of Instruction				Scheme of examination			Credits
			L	T	Pr/Drg	Contact Hrs / wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	PE - II	Professional Elective-II	3			3	30	70	3	3
2	PE - III	Professional Elective-III	3	-	-	3	30	70	3	3
3	PE - IV	Professional Elective-IV	3	-	-	3	30	70	3	3
Practical / Laboratory Courses										
4	PC851AE	Seminar	-	-	2	2	25	-	-	1
5	PC852AE	Project Work	-	-	9	9	50	Grade	-	6
Total			**9**	**-**	**11**	**20**	**165**	**210**	**-**	**16**

Professional Elective- II

S.No	Course Code	Professional Elective-II	Scheme of Instruction			Contact Hrs/Wk	Scheme of Examination		Credits
			L	T	P/Dg		CIE	SEE	
1.	PE711AE	Vehicle Dynamics	3	--	--	3	30	70	3
2.	PE712AE	Modern Machining & Forming Methods	3	--	--	3	30	70	3
3.	PE713AE	Composite Materials	3	--	--	3	30	70	3
4.	PE714AE	Autotronics	3	--	--	3	30	70	3

Professional Elective- III

S.No	Course Code	Professional Elective-III	Scheme of Instruction			Contact Hrs/Wk	Scheme of Examination		Credits
			L	T	P/Dg		CIE	SEE	
1.	PE811AE	Transport Management	3	--	--	3	30	70	3
2.	PE812AE	Non-Conventional Energy Sources	3	--	--	3	30	70	3
3.	PE813AE	Machine Tool Engineering & Design	3	--	--	3	30	70	3
4.	PE814AE	Robotic Engineering	3	--	--	3	30	70	3

Professional Elective- IV

S.No	Course Code	Professional Elective-IV	Scheme of Instruction			Contact Hrs/Wk	Scheme of Examination		Credits
			L	T	P/Dg		CIE	SEE	
1.	PE821AE	Automotive Pollution & Control	3	--	--	3	30	70	3
2.	PE822AE	Additive Manufacturing Technology	3	--	--	3	30	70	3
3.	PE823AE	Entrepreneurship	3	--	--	3	30	70	3
4.	PE824AE	Non-Destructive Testing	3	--	--	3	30	70	3

BS: Basic Sciences ES: Engineering Sciences MC: Mandatory Course
PC: Professional Course HS: Humanities and Sciences
L: Lectures T: Tutorials Pr: Practicals Drg: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour
2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core / Elective</td></tr>
<tr><td>PE711AE</td><td colspan="6">Vehicle Dynamics</td><td>Elective</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact hours per week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>Engineering Physics, Engineering Mechanics, Dynamics of Machines and Mechanical Vibrations</td><td>3</td><td>--</td><td>--</td><td>--</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- **Identify** the difference between static loads and dynamic loads on vehicle and vibration responses. Identification of various vibration measuring instruments and methods of measuring them.
- **Review** the performance of a vehicle in braking and acceleration
- **Assess** different road loads on vehicle
- **Provide** ride and handling concepts of a vehicle

Course Outcomes

After completion of the course the student is able to

- **Calculate** static loads and dynamic loads on vehicle, vibrational frequencies
- **Evaluate** different braking and acceleration forces
- **Estimate** different road loads of a vehicle
- **Identify** difference between ride and handling of a vehicle

UNIT I

Fundamentals of Vibration: Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT – II

Vehicle Vibrations: Vehicle vibration with single degree of freedom free vibration, forced vibration, vibration due to road roughness, vibration due to engine unbalance, transmissibility of engine mounting vibration with two degree of freedom, free vibration, compensated suspension systems forced vibration.

UNIT – III

Different types of Tyres – Materials used: Tyre construction, physics of tyre traction on dry and wet surface, tyre traction on dry and wet surface, tyre foces and moments, SAE recommended terminologies of tyre road interaction.

UNIT – IV

Numerical Methods for Multi Degree of Freedom Systems: Methods, influence coefficient. Maxwell's reciprocal theorem. Dunkerley's equation, orthogonality principle, method of matrix iteration – method of determination of all the natural frequencies using sweeping matrix and orthogonality principle, Holzer's method for systems with free, fixed free and fixed ends.

UNIT – V

Vibration measuring instruments – Accelerometers and vibrometers, whirling of shafts with and without air damping, discussion of speeds above and below critical speeds.

Suggested Readings:

1. Vehicle Dynamics - by J S Rao V.Dukkipati
2. Theory of Vibration with applications - by William J Thomson
3. Theory & Problems of Mechanical Vibration – by William W. Seto, McGraw Hill
4. Problems in Automobile Mechanics – by N.K. Giri, Khanna Pub.
5. Mechanics of Pneumatic Tyre – by S.K. Clark, Prentice Hall.
6. Mechanical Vibration – by Church- Wylie international

Course Code	Course Title						Core / Elective
PE712AE	Modern Machining & Forming Methods						Elective
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	--	--	--	**30**	**70**	**3**

Course Objectives

- To understand the working principle of Ultra Sonic Machining and Abrasive Jet Machining
- To familiarize with Electro Discharge Machining
- To get thorough knowledge on Laser Beam Machining Electro Beam Machining
- To understand the principles of Rubber Pad Forming and Electro Hydraulic Forming
- To understand the working of different components of Stretch Forming, Tube Spinning, Hydrostatic Forming and Water Hammer Forming.

Course Outcomes

The student is able to

- Demonstrate Ultrasonic Machining and Abrasive Jet Machining.
- Explain the working principle Electro Discharge Machining
- Apply Rubber Pad Forming and Electro Hydraulic Forming methods in automobiles
- Demonstrate Rubber Pad Forming and Electro Hydraulic Forming
- Distinguish between Stretch Forming, Tube Spinning, Hydrostatic Forming and Water Hammer Forming processes and select the suitable them for the required applications.

Unit-I

Ultra Sonic Machining (USM): Introduction, process description, abrasive slurry, Abrasive materials and their characteristics. Functions of liquid medium in slurry, Types of Transducers, effect of process parameters, applications and limitations. Abrasive Jet Machining (AJM): Principle of operation, process details, process variables and their effect on M RR and accuracy. Equation for MRR Advantage, disadvantages and applications. Water Jet Machining (WJM): Schemetic diagram, equipment used, advantages and applications.

Unit-II

Electro Discharge Machining (EDM): Process description with schematic diagram, process parameters, functions and characteristics of dielectrics medium, dielectric fluids, over cut and side taper’ Flushing, Mechanism of metal removal, crater volume, types of power supply circuits, mathematical analysis of metal removal rate (MRR), characteristics of spark eroded surfaces, advantages, disadvantages and applications.

Wire EDM: Process description and application. Electro-Chemical Machining (ECM): Schematic of the process parameters, function and characteristics of electrolyte, chemistry of the process, Equation for specific MRR and electrode feed rate, advantages, limitations and applications, Rotary Machining, Hot machining, high speed machining, description of each process, process parameters, advantages and applications.

Unit-III

LASER Beam Machinning (LBM): Principle of LASER Beam production, materials used, thermal analysis of process, process parameters, equqtions for power density and machining rate, advantages, limitations and applications.

Plasma Arc Machining (PAM): Introduction, equipment used , process description and parameters, types of plasma arc: Transferred aarc and non transferred arc and process applications.
Electron Beam Machining (EBM): Schematic of the process, process parameters, principal of production of Electron Beam, equipment used, Advantages, disadvantages and applications. ION Etching: Process description and applications.

Unit-IV
Rubber Pad Forming: Principal of the process, process details and its types: Guerin, wheel on, Marfoming and Hydro Forming processes and applications.
Electro-Hydraulic Forming (EHF): Schematic of the process description and its applications.
High Energy Rate Forming (HERF): HERF hammers, principal of explosive forming, Explosive materials, types of explosive forming, stand off operation and contact operation, the pressure pulse, Gas bubble and the process applications.

Unit-V
Stretch Forming: Introduction types of stretch forming: stretch draw forming, rotary stretch forming or stretch wrapping, compression forming, radial draw forming. Stretch forming equipment and accessories, accuracy and surface finish, process variables and limitations.
Tube Spinning: Introduction, methods of tube spinning, Backward spinning, forward spinning, machines and tools used. Machine variables, speeds and feeds, effect of tube spinning on work mortal properties and applications.
Hydrostatic Forming: Process principle, description and applications.
Water Hammer Forming (WHF): Schematic diagram of the process, principle of operation, process variables, work materials, process limitations and applications.

Suggested Reading:

1. P.C.Pandey and H.S Shah, Modern Machining Process",Tata Mc Graw Hill publishing Co.Ltd., New Delhi, 1980.
2. A. Bhatacharya, New Teachnology", The Institution of Engineers (India), 1984.
3. Davies and Austin, Developments in High Speed Metal Forming", The Machinery Publishing Co. Ltd., 1985.
4. Production Technology:-HMT.

Course Code	Course Title	Core / Elective
PE713AE	Composite Materials	Elective

Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	--	--	--	**30**	**70**	**3**

Course Objectives

- To understand different types of composites
- To understand different manufacturing methods for composite materials and their properties
- To understand micromechanics of composites
- To understand macromechanics of composites
- To know the strength of composites

Course Outcomes

The student is able to

- Classify between different types of composites
- Evaluate properties of composite materials by using different methods
- Evaluate mechanical and thermal properties
- Estimate properties of lamina and classify laminated composites
- Determine tensile, compressive and laminated strength of composites

UNIT - I

Introduction: Definition and classification of Composites (PMC, MMC, CMC), FRP Composites, Fiber Reinforcements: Fiber Types and its properties, Fiber Forms, Matrix materials and its properties: Thermoset Matrices, Thermoplastic Matrices, Applications of Composite Materials.

UNIT - II

Manufacturing Processes: Hand-Lay-up, Prepreg Lay-up, Bag Molding, Autoclave processing, Compression Molding, Resin Transfer Molding, Pultrusion, Filament Winding, Gel time test for resins, Curing Cycle.

Measurement of Basic Composite Properties: Fiber and matrix tests, Tensile test, Compressive test, in-plane shear test, interlaminar shear test, flexure test.

UNIT - III

Micromechanics of Composites: Basic Concepts: Volume and Mass fraction, Heterogeneous, Anisotropic, Orthotropic, Transversely Isotropic and Isotropic Materials.

Mechanical Properties: Prediction of Elastic constants, micromechanical approach, Stress Partitioning Parameter, Halpin-Tsai equations.

Thermal Properties: Thermal Expansion, Moisture Expansion, Transport Properties.

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, Classification of Laminated composites, analysis of laminated composites, stresses and strain with orientation, Interlaminar stresses and edge effects.

UNIT - V

Strength of Orthotropic Lamina: Tensile and compressive strength of unidirectional fiber composites, fracture modes in composites, delamination failure, Maximum stress theory, Maximum Strain theory, Tsai-Hill Criterion, Tsai-Wu Criterion.

Laminate Strength: First Ply Failure, Fiber Failure, Truncated- Maximum- Strain Criterion.

Suggested Readings:

1. Ronald F.Gibson, "Principles of Composite Materials Mechanics", McGraw-Hill, Inc, 1994.
2. Krishna, K,Chewla, "Composite Materials", Springer-Verlag, 1987.
3. Carl. T.Herakovich, " Mechanics of Fibrous Composites", John Wiley Sons inc., 1998.
4. Ever J. Barbero, "Introduction to Composite Materials Design", Taylor & Francis, 1999.
   Jones, R.M., Mechanics of Composite Materials", McGraw-Hill Co., 1967

Course Code	Course Title						Core / Elective
PE714AE	Autotronics						Elective
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	--	--	--	**30**	**70**	**3**

Course Objectives:
- To justify the need of Autotronic Systems and explain the construction of various electronically components.
- To Understand Electronic ignition systems and electronic fuel control.
- To know Engine management system
- To know the chassis electrical systems and Electromagnetic interference suppression
- To know Electronics for comfort, safety and security

Course Outcomes:
- On completion of the course the student must be able to understand and realize, the concepts of
- The need of Autotronic and various electronically components.
- Electronic ignition systems and electronic fuel control.
- Engine management system
- Chassis electrical systems and Electromagnetic interference suppression
- Electronics for comfort, safety and security

UNIT - I

Introduction: Need for electronics in automotive control systems, structure of vehicle electronics systems, common features of vehicle systems, measurement system, sensors and actuators.

Introduction to Electronics: Electronic components, diodes, transistors, electronic circuits, analog circuits, digital circuits, integrated circuits, microprocessor systems, systems approach to control and instrumentation.

UNIT - II

Electronic ignition systems: Types of ignition systems, conventional ignition system, CDI, programmed ignition system, distributor-less ignition system, direct ignition.

Electronic fuel control: Electronic control of carburetion, petrol injection system, single and multi-point injection system, components, flow diagram, diesel fuel injection.

UNIT - III

Engine Management System: Combined ignition and fuel management system, exhaust emission control, digital control techniques, complete vehicle control systems, artificial intelligence and engine management.

UNIT - IV

Chassis Electrical Systems: Anti-lock brakes, active suspension, traction control, electronic control of automatic transmission.

Electromagnetic Interference Suppression: Electromagnetic compatibility Electronic dash board instruments - Onboard diagnosis system. Security and warning system

UNIT-V

Electronics for Comfort, Safety And Security: Electric seats, mirrors and sun-roof operation, central looking and electric windows, cruise control, In Car Entertainment (ICE) and communications, adaptive noise control, airbags and seatbelt tensioners, obstacle avoidance radar, security systems - engine immobilizer, ICAT.

Suggested Reading

1. Automotive electrical and electronic systems: Tom Denton, 3rd edition, SAE International.
2. Automotive electronics: Eric Chowanietz, Newnes, 1995.
3. Understanding automotive electronics, William B Ribbens, Butterworth-Heinemann.
4. Electrics Automotive Electronics, Robert Bosch.

Professional Elective- III

Course Code	Course Title						Core / Elective
PC801AE	Transport Management						Core
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	--	--	--	**30**	**70**	**3**

Course Objectives:

- To understand the concept of personal Management and selection process.
- To Understand the Transport organization structure and passenger transport operation and understand the bus Scheduling and Fare Structure.
- To Understand goods transport operation**,** Scheduling of goods transport, Advance Techniques in Traffic Management and Forms of ownership
- To understand the Motor Vehicle Act, insurance, and constructional regulations
- To understand the vehicle Maintenance system in transport industry Causes for uneven tyre wear and maintenance procedure for better fuel economy.

Course Outcomes:

On completion of the course the student must be able to

- understand and realize, the concepts of personal Management and selection process
- Prepare organization structure and passenger transport operations.
- Implement Motor Vehicle Act, insurance, and constructional regulations
- Motor Vehicle Act, insurance, and constructional regulations
- Perform maintenance of the vehicle.

UNIT – I

Introduction personnel management: Objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

UNIT – II

Transport systems: Introduction to various transport systems

Passenger transport operation: Structure of passenger transport organizations- Typical depot layouts. Scheduling and Fare Structure: Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table, various types of fare collecting methods. Basic factors of bus scheduling.Problems on bus scheduling.

UNIT – III

Goods Transport Operation: Structure of goods transport organizations- Scheduling of goods transport- Management Information System (MIS) in passenger / goods transport operation- Storage & transportation of petroleum products- Advance Techniques in Traffic Management- Traffic navigation- Global positioning system.Forms of ownership and advantages of motor transport.

UNIT – IV

Motor Vehicle Act: Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.training for drivers & conductors

UNIT – V

Maintenance: Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout.

Suggested Reading

1. John Duke - Fleet Management – McGraw-Hill Co, USA -1984.
2. Government Motor Vehicle Act – Eastern Book Company, Lucknow– 1989
3. Kitchin.L.D., - Bus Operation - Illiffee and Sons Co., London, III edition – 1992
4. The motor vehicle Act 1939 - EjazAhemad, Ashok law house, India - 1989

Course Code	Course Title						Core / Elective
PE812AE	Non-Conventional Energy Sources						Elective
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	--	--	--	**30**	**70**	**3**

Course Objectives:

- To understand the concepts and applications of non-conventional energy sources.
- To learn the principles of power generation - solar, wind, biomass, waste heat recovery
- To know the terminology used in solar technology and understand Solar engines
- To know the sources of geothermal energy and its applications.
- To understand the working principles of Wave, tidal and OTEC systems.

Course Outcomes:

Students will be able to:

- Select any Non-Conventional Energy Source equipment and apply concept of heat transfer and obtain the results.
- Apply solar energy in solar engines
- Able to design a wind mill.
- Apply geothermal energy for different applications
- Able to design a solar collector for different applications.

Unit-I

Statistics on conventional energy sources and supply in developing countries, Definition-Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES. Classification of NCES-Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources.

Unit-II

Solar Energy-Energy available form Sun, Solar radiation data, Solar energy conversion into heat, Flat plate and Concentrating collectors, Mathematical analysis of Flat plate collectors and collector efficiency, Principle of Natural and Forced convection, Solar engines-Stirling, Brayton engines, Photovoltaic, p-n junction, solar cells, PV systems, Stand-alone, Grid connected solar power satellite.

Unit-III

Wind energy conversion, General formula -Lift and Drag- Basis of wind energy conversion - Effect of density, frequency variances, angle of attack, and wind speed. Windmill rotors-Horizontal axis and vertical axis rotors. Determination of torque coefficient, Induction type generators- working principle.

Unit-IV

Nature of Geothermal sources, Definition and classification of resources, Utilization for electric generation and direct heating, Well Head power generating units, Basic features- Atmospheric exhaust and condensing, exhaust types of conventional steam turbines.

Pyrolysis of Biomass to produce solid, liquid and gaseous fuels, Biomass gasification, Constructional details of gasifier, usage of biogas for chulhas, various types of chulhas for rural energy needs.

Unit-V

Wave, Tidal and OTEC energy- Difference between tidal and wave power generation, Principles of tidal and wave power generation, OTEC power plants, Operational of small cycle experimental facility, Design of 5 Mw OTEC pro-commercial plant, Economics of OTEC, Environmental impacts of OTEC. Status of multiple product OTEC systems.

Suggested Reading:

1. Ashok V Desai, *Non-Conventional Energy,* Wiley Eastern Ltd, New Delhi, 2003
2. Mittal K M, *Non-Conventional Energy Systems,* Wheeler Publishing Co. Ltd, New Delhi, 2003.
3. Ramesh R & Kumar K U, *Renewable Energy Technologies,* Narosa Publishing House, New Delhi, 2004
4. Wakil MM, *Power Plant Technology,* Mc Graw Hill Book Co, New Delhi, 2004.

Course Code	Course Title						Core / Elective
PE813AE	Machine Tool Engineering & Design						Elective
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	--	--	--	**30**	**70**	**3**

Course Objectives

- To know tool materials, tool geometry, chip formation and machining methods
- To understand heat distribution, tool wear and tool life.
- To understand specifications and construction of machine tools
- To understand the working of grinding machines and gear manufacturing methods
- To know the working principle of Jigs, Fixtures and Unconventional machining

Course Outcomes

The student is able to

- Select material for tools and perform machining operations
- Improves the tool life
- Identify a machine tool for the required operation
- Select grinding machine and perform various grinding operations.
- Use Jigs and fixtures for various machining operations and apply Non-Conventional Machining processes for special applications.

UNIT-I

Cutting Tool Materials: High carbon steel, HSS, Stellites, Carbides, Coated carbides, Diamonds. Tool material properties.

Tool Geometry: Nomenclature of single point cutting tool by ASA & ORS systems. Geometry of drills, milling cutters.

Chip Formation: Types of chips, BUE, Chip breakers.

Machining: Orthogonal and oblique cutting, Mechanics of metal cutting, Merchant's analysis, Shear angle, Solutions of Merchant and Lee & Shafer.

UNIT-II

Thermal Aspects of Metal Cutting: Sources of heat and heat distribution, Various methods of measurement of temperature, Cutting fluids and applications.

Tool Wear, Tool Life and Machinability: Types of wear, mechanism of tool wear, Tool life & Machinability, Machinability index. Taylor's tool life equation.

Economics of Machining: Tool life for maximum production, minimum cost.

UNIT-III

Machine Tools: Constructional features and specifications of machine tools, various operations on Lathe, Types of Lathes, capstan and turret Lathes, Drilling, Milling and, Boring machines. Indexing methods. Differences between shaper, planer and slotter. Tool holding and work holding devices. Quick return mechanisms.

UNIT-IV

Grinding Machines: Types of grinding, Abrasives and bonds used for grinding wheels. Specification and selection of grinding wheels. Broaching, Lapping, Honing, Polishing, Buffing and super finishing, Burnishing.

Screws and Gear Manufacturing: Tapping, Chasers, Thread rolling, Thread milling, thread grinding. Gear shaping, Gear hobbing, Gear shaving and grinding.

UNIT-V

Jigs and Fixtures: Design principles for location and clamping. Quick clamping devices. Types of Jigs and fixtures.

Unconventional Machining: Principles of working and applications of USM, AJM, EDM, ECM, LBM and EBM (Mechanism and Theory of MRR and Process parameters in each case).

Suggested Reading:

1. B.L. JuneJa and Shekon, *"Fundamentals of Metal Cutting & Machines Tools",* Wiley Eastern Ltd. 1987.
2. P.N. Rao, *"Manufacturing Technology – Metal Culling & Machine Tools",* Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.
3. Amitab Ghosh and Mallick, *"Manufacturing Science",* Affiliated East West Press 1985.
4. P.C, Pandey & Shan HS, *"Modern Machining Process",* Tata McGraw-Hill Education 1980.
5. A. Bhattacraryya, "*Metal Cutting Theory and Practice*" New Central Book Agency (P) Ltd., Calcutta, 1996.

Course Code	Course Title						Core / Elective
PE814AE	Robotic Engineering						Elective
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	--	--	--	**30**	**70**	**3**

Course Objectives

- To familiarize the student with the anatomy of robot and their applications.
- To provide knowledge about various kinds of end effectors usage.
- To equip the students with information about various sensors used in industrial robots.
- To make the student understand the importance of spatial transformation of robots using forward and inverse kinematics.
- To specify and provide the knowledge of techniques involved in robot vision in industry.
- To equip students with latest robot languages implemented in industrial manipulators.

Course Outcomes

- Able to demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics and have an understanding of the functionality and limitations of robot actuators and sensors.
- Able to demonstrate an ability to apply spatial transformation to obtain forward/Inverse kinematics equation of robot manipulators using analytical/numerical/simulation tools.
- Able to apply knowledge and choose the best & economically suitable sensors/end effectors required for specific applications.
- Able to understand the importance of robot vision and apply the learnt techniques to get the required information from input images.
- Able to design and develop a industrial robot for a given purpose economically.
- Appreciate the current state and potential for robotics in new application areas

UNIT – I

Introduction to Robotics: Basic structure of Robots. Degree of freedom of Robots, Work envelope,Classification of Robots based on Drive Technology, Work-Envelope and motion control methods.

Application of Robots in Industry, Repeatability, Precision and Accuracy as applied to Robots, Specifications of robots used for various applications. End effectors, Grippers: Mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, RCC grippers, Two fingered and three fingered grippers, internal grippers and external grippers, Selection and design considerations.

UNIT – II

Requirements of a Sensor: Principles and Applications of the following types of sensors- Position ofsensors (Piezo electric sensor, LVDT, Resolvers, Optical encoders, Pneumatic position sensors), Range sensors (Triangulation principle, Structured, Lighting approach, Time of flight range finders, Laser range meters), Proximity sensors (Inductive, Hall effect, Capacitive, Ultrasonic and Optical proximity sensors), Touch sensors (Binary sensors, Analog sensors), Wrist Sensors, Compliance Sensors, Slip Sensors.

UNIT – III

Kinematic Analysis of Robots: Rotation matrix. Homogeneous transformation matrix, Denavit&Hartenberg representation, Euler and RPY angles representation. Representation of absolute position and orientation in terms of joint parameters, Direct Kinematics of manipulators, Inverse kinematics of Robot arm for position and orientation. Redundancy in Robots, Static force analysis

UNIT – IV

Introduction to Techniques used in Robot Vision: Image acquisition, illumination techniques,imaging geometry, basic relationship pixels, preprocessing, segmentation & description of 3-dimensional structures, their recognition and interpretation. Types of Camera, frame grabbing, sensing and digitizing image data, Signal conversion, Image Storage, Lighting techniques, Image processing and analysis, Data reduction, Segmentation, Feature extraction, Object recognition, and various algorithms, Applications, Inspection, identification, visual serving and navigation.

UNIT – V

Robot Programming Languages: Characteristics of robot level languages, task level languages.Teach pendant programming, Lead through programming, Robot programming languages, VAL programming, Motion commands, Sensor commands. End effecter commands, Simple programs. RGV, AGV, Implementation of robots in industries, various steps, Safety considerations for robot operations. Economic analysis of robots, Pay back method, EUAC method and Rate of return method.

Suggested Readings:

1. Groover M P, "Industrial Robotics", McGraw Hill Publications, 1999.
2. Fu. K.S., GonZalez R.C., Lee C.S.G. "Robotics, Control-sensing vision anIntelligence", McGraw Hill, Int. Ed., 1987.
3. Spong and Vidyasagar, "Robot Dynamics & Control", John Wiley and Sons, Ed.,1990.
4. Mittal and Nagrath, "Industrial Robotics", Tata McGraw Hill Publications, 2004.
5. Saha&Subirkumarsaha, ‘Robotics’, TMH, India.

Professional Elective- IV

<table>
<tr><td>Course Code</td><td colspan="4">Course Title</td><td colspan="2"></td><td>Core / Elective</td></tr>
<tr><td>PE821AE</td><td colspan="6">Automotive Pollution & Control</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact hours per week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>NIL</td><td>3</td><td>--</td><td>--</td><td>--</td><td>30</td><td>70</td><td>3</td></tr>
</table>

Course Objectives

- To know different pollutants from automobiles and their effect on health and environment.
- To understand the mechanism of pollutants formation in SI and CI Engines
- To understand the effect of engine design and operating variables of the engine to control emissions.
- To understand the test procedure of pollution measuring devices

Course Outcomes

The student is able to

- Analyze the sources of pollutants and operational effects on pollutants
- Explain the mechanism of pollutants formation in SI and CI Engines.
- Explain the methods to control emissions
- Explain the test procedure of different emission measuring devices

UNIT – I

Introduction: Vehicle population assessment in metropolitan cities and contribution to pollution, effects on human health and environment, global warming, types of emission, transient operational effects on pollution.

UNIT – II

Pollutant Formation in SI Engines: Pollutant formation in SI Engines, mechanism of HC and CO formation in four-stroke and two-stroke SI engines, NOx formation in SI engines, effects of design and operating variables on emission formation, control of evaporative emission. Two-stroke engine pollution.

UNIT – III

Pollutant Formation in CI Engines: Pollutant formation in CI engines, smoke and particulate emissions in CI engines, effects of design and operating variables on CI engine emissions. NOx formation and control. Noise pollution from automobiles, measurement and standards.

UNIT – IV

Control of Emissions from SI and CI Engines: Design of engine, optimum selection of operating variables for control of emissions, EGR, Thermal reactors, secondary air injection, catalytic converters, catalysts, fuel modifications, fuel cells, Two-stroke engine pollution control.

UNIT – V

Measurement Techniques Emission Standards and Test Procedure: Orsat Apparatus, NDIR, FID, Chemiluminescent analyzers, Gas Chromatograph, smoke meters, emission standards, driving cycles – USA, Japan, Euro and India. Test procedures – ECE, FTP Tests. SHED Test – chassis dynamometers, dilution tunnels

Suggested Reading

1. Paul Degobert – Automobiles and Pollution – SAE International ISBN-1-56091-563-3, 1991.
2. Ganesan, V- "Internal Combustion Engines"- Tata McGraw-Hill Co.- 2003.
3. SAE Transactions- "Vehicle Emission"- 1982 (3 volumes).
4. Obert.E.F.- "Internal Combustion Engines"- 1988
5. Marco Nute- " Emissions from two stroke engines, SAE Publication – 1998

Course Code	Course Title						Core / Elective
PE822AE	Additive Manufacturing Technology						Elective
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	--	--	--	**30**	**70**	**3**

Course Objectives

- To understand the fundamental concepts of Rapid Prorotyping and its classification, advantages and limitations
- To know the working principles of Liquid based and Powder based Rapid prototyping systems
- To understand data formats of Rapid prototyping systems
- To know the applications of data formats of Rapid prototyping systems

Course Outcomes

The student is able to

- Classify Rapid prototyping systems
- Demonstrate working principle of Liquid based and Powder based Rapid prototyping systems
- Prepare data formats of Rapid prototyping systems
- To understand and realize file transfer protocols related to RPT

UNIT-I

Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of R P Process, Rapid Prototyping Process Chain: Fundamental Automated Processes, Process Chain.

UNIT-II

Liquid-based Rapid Prototyping 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 Rapid Prototyping Systems: Laminated 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 Rapid Prototyping 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. Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification; Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling**:** Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP

UNIT-IV

Rapid Prototyping 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

RP Applications : Application - Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry 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.

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. Pham and S.S. Dimov, *Rapid Manufacturing,* Springer, 2001.
3.Terry Wohlers, *Wholers Report 2000,* Wohlers Associates, 2000.
4.Paul F.Jacobs, *Rapid Prototyping & Manufacturing* ASME Press, 1996.

Course Code	Course Title						Core / Elective
PE823AE	Entrepreneurship						Elective
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	--	--	--	**30**	**70**	**3**

Course Objectives

- To know Indian industrial environment
- To understand characteristics of entrepreneurs
- To know project formulation, analysis of market demand, financial and technical aspects.
- To understand project planning and control
- To understand behavioral aspects of entrepreneurs

Course Outcomes

The student is able to

- Analyze the challenges for entrepreneurs
- Evaluate concepts, ideas of entrepreneurs
- Analyze market demand, financial and technical aspects of the project
- Manage the project with better planning and control
- Change behavioral aspects

UNIT - I

Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types and forms of enterprises.

UNIT - II

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

UNIT - III

Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis. project financing in India.

UNIT - IV

Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Hum;," aspects of project management. Assessment of tax burden.

UNIT - V

Behavioural aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths and weakness. The urgency addiction and time management matrix.

Suggested Reading:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya publishing House, 1997.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata Mcgraw-Hill Publishing Company Ltd. 1995
3. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster publication, 1994.
4. G.S. Sudha, "Organizational Behaviuor", National publishing house, 1996.
5. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", Tata Mc graw Hill Publishing Company Ltd., 5th Ed., 2005.

Course Code	Course Title						Core / Elective
PE824AE	Non-Destructive Testing						Elective
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	--	--	--	**30**	**70**	**3**

Course Objectives:

- To get an overview of NDT
- To understand Principles, types and properties of liquid penetrants,developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results.
- To understand the working principles and procedures of thermography and eddy current testing
- To understand the working principles and procedures of Ultrasonic Testing and Acoustic Emission
- To understand the concept of Radiography

Course Outcomes:

Upon the completion of this course the students will be able to

- Explain the fundamental concepts of NDT
- Discuss the different methods of NDT
- Explain the concept of Thermography and Eddy current testing
- Explain the concept of Ultrasonic Testing and Acoustic Emission
- Explain the concept of Radiography

UNIT I

Overview of NDT: NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, various physical characteristics of materials and their applications in NDT., Visual inspection –Unaided and aided.

UNIT II

Surface NDT Methods: Liquid Penetrant Testing - Principles, types and properties of liquid penetrants,developers, advantages and limitations of various methods, Testing Procedure, Interpretation ofresults. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisationmethods, Interpretation and evaluation of test indications, Principles and methods ofdemagnetization, Residual magnetism.

UNIT III

Thermography and Eddy Current Testing (ET): Thermography- Principles, Contact and non-contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT IV

Ultrasonic Testing (UT) and Acoustic Emission (AE): Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array**,** Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique – Principle, AE parameters, Applications.

UNIT V

Radiography (RT): Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films -graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts,Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, ComputedTomography

Suggested Readings:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2014.
2. Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New AgeInternational Publishers, 2010

References:

1. ASM Metals Handbook, ”Non-Destructive Evaluation and Quality Control”, American Society ofMetals, Metals Park, Ohio, USA, 200, Volume-17.
2. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1,Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4,Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol.7, Ultrasonic Testing.
3. Charles, J. Hellier,“ Handbook of Nondestructive evaluation”, McGraw Hill, New York 2001.

Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition
NewJersey, 2005.

Course Code	Course Title						Core / Elective
PC851AE	Seminar						Core
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
NIL	--	--	--	2	**25**	**--**	**1**

Oral presentation is an important aspect of engineering education.
The objective of the seminar os to prepare the student for a systematic and independent study of state of the art topics in a broad area of his I her specialization.

Seminar topics may be chosen by the students with advice from the faculty members . Students are to be exposed to following aspects of seminar presentations.
Literature survey organisation of material
Preparation of OHP slides / PC presentation Technical writing
Each student will be required to

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Give a 20 minutes presentation through OHP, PC, Slide projector followed by 10 minutes discussion.
3. Submit a report on the seminar topic with list of reference and slides used.

Seminars are to be scheduled from the 3rd week to the last week of the semester and any change in schedule should be discouraged.
The sessional marks will be awarded to the students by at least 2 faculty members on the basis of an oral and a written presentation as well as their involvement in the discussions.

<table>
<tr><td>Course Code</td><td colspan="4">Course Title</td><td colspan="2"></td><td>Core / Elective</td></tr>
<tr><td>PC852AE</td><td colspan="6">Project Work</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact hours per week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>NIL</td><td>--</td><td>--</td><td>--</td><td>9</td><td>50</td><td>Grade</td><td>6</td></tr>
</table>

Solving a real life problem should be the focus of U.G project Faculty members should prepare project briefs well in advance. They should be made available to the students at the Department Library. A Project may be classified as hardware/ software/ modelling/ simulation. It should involve elements such as analysis, design and synthesis.

The Department will appoint a project coordinator who will be in –charge of the following

- Grouping of students (Maximum of three in a group).
- Allotment of projects and project guide.
- Project monitoring at regular intervals.

A project allotment is to be completed by the 4^{th} week of 1^{st} semester of IV year so that students get sufficient time for completion of their project.

All the projects are to be checked for progress at least twice in a semester. It should be on the basis of presentation of the students.

Sessional marks to be based on the Grade / Marks awarded by a monitoring committee comprising of faculty members as well as by the supervisor.

Efforts to be made so that some of the projects are carried out in industries. Projects may also be invited from industries. Norms of final documentation of the project report are to be provided by the Department.

**Excellent/ Very Good/ Good/ Satisfactory/ Unsatisfactory.*

Note: Three periods of contact load will be assigned to each project guide.