Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Academic Year

SCHEME OF INSTRUCTION & EXAMINATION

AICTE Model Curriculum

B. E. VIII – Semester (PRODUCTION ENGINEERING)

(wef: 2021-2022)

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	PE-PE-V	Professional Elective-V	3	-	-	3	30	70	3	3
2	PE-PE-VI	Professional Elective-VI	3	-	-	3	30	70	3	3
3	OE-PE-III	Open Elective-III	3	-	-	3	30	70	3	3
Practical / Laboratory Course										
4	PW703ME	Project-II	-	-	16	16	50	150		8
Total										**17**

PROFESSIONAL ELECTIVE - V		
S. No.	**Course Code**	**Course Title**
1	PE811PE	Composite Materials
2	PE812PE	Industrial Engineering
3	PE813PE	Design of Metal Cutting Tools and Accessories

PROFESSIONAL ELECTIVE - VI		
S. No.	**Course Code**	**Course Title**
1	PE821PE	Non-Destructive Testing
2	PE822PE	Total Quality Management
3	PE823PE	Design of Press Tools

Open Elective – III		
1	OE801 CE	Road Safety Engineering (Not for Civil Engg. Students)
2	OE801CS	Fundamentals of AI & ML (Not for CSE & IT students)
3	OE801 EE	Smart Building Systems (Not for EEE & EIE Students)
4	OE802 EE	Programmable Logic Controllers (Not for EEE & EIE Students)
5	OE801EC	Principles of Electronic Communications (Not for ECE students)
6	OE801IT	Software Engineering (Not for IT Students)
7	OE801ME	3D Printing Technologies (Not for Mechanical and Production students)
8	OE801AE	Elements of Electrical and Hybrid Vehicle Technology

PC: Professional Core **PE:** Professional Elective **OE: Open Elective**

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 hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Academic Year

Code: PC811PE

COMPOSITE MATERIALS
(Professional Elective-V)

Credits: 3

Instruction: 3 periods per week *Duration of SEE: 3 hours*

CIE: 30 marks *SEE: 70 marks*

Objectives:

The objectives of this course are to:

1. Discuss the basic structure of composites
2. Define Elastic constants and Hygro-thermal stresses
3. identify stress-strain relations in composites
4. Describe the behaviour and Design with composites
5. Demonstrate the basic equations of plate bending

Outcomes:

On completion of the course the student will be able to:

1. demonstrate knowledge of composites and their structure
2. predict the Elastic constants and Hygrothermal stresses
3. analyse the stress - strain relationship in composites
4. summarise and apply the Design procedure and the failure criteria.
5. formulate Plate 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

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

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.

Code: PC812PE

INDUSTRIAL ENGINEERING

(Professional Elective-V)

Credits: 3

Instruction: 3 periods per week *Duration of SEE: 3 hours*

CIE: 30 marks *SEE: 70 marks*

Objectives:

1. To learn the concept of Management.
2. To understand role of Production Planning and Control in Industry.
3. To learn various material procurement policies.
4. To understand importance of quality control and various methods.
5. To interpret the role of Decision theory in Industry.

Outcomes:

After completing this course, the student will be able to

1. Explain various approaches for industrial management. Able to infer concept of management in human resource domain
2. Apply Philosophy of Production Planning and Control in Industry and control the activities in delivering the products in time
3. Determine the optimum requirement of inventory by developing the various quantitative models.
4. Develop various models or methods for ensuring the required quality of the products orprocesses.
5. 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

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

Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Academic Year

Code: PC813PE

POWER PLANT ENGINEERING

(Professional Elective-V)

Credits: 3

Instruction: 3 periods per week *Duration of SEE: 3 hours*

CIE: 30 marks *SEE: 70 marks*

Objectives:

Student has to understand the

1. Operation of steam turbine and gas turbine power plants
2. About hydraulic power plant, hydrology, dams and spillways
3. Various types of nuclear power plantsincluding Pressurized water reactor, Boiling water reactor, Liquid metal fast breeder reactor and Gas cooled reactor
4. The power plant economics
5. The environmental and safety aspects of power plant operation.

Outcomes:

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

1. Select coal and ash handling methods for a coal fired power plant.
2. Comprehend basic working principle of steam and gas turbine power plant
3. Classify Dams and Spillways.
4. Demonstrate the basic principles of thermal-fission and fast-breeder nuclear power plants, such as pressurized- water, boiling-water, and heavy-water reactors.
5. Analyse load factor, capacity factor, average load and peak load on a power plant.
6. 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 -radioactive 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 Reading:

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,* Dhanpat Rai & 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.

Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Academic Year

Code: PC821PE

NON-DESTRUCTIVE TESTING
(Professional Elective-VI)

Credits: 3

Instruction: 3 periods per week *Duration of SEE: 3 hours*

CIE: 30 marks *SEE: 70 marks*

Objectives:

Student has to understand the

1. Need, basic concepts and technologies of Non-Destructive Testing (NDT)
2. Security precautions from Radiography, protection from radiation and measurement of radiation received by personnel.
3. Technology of acoustic emission (AE), the associated instrumentation and applications
4. Technologies like neutron radiography; laser induced ultrasonics, surface analysis andthermography
5. Merits and demerits of the different NDT Technologies
6. Latest research and developments in NDT

Outcomes:

1. The knowledge of different NDT techniques.
2. Clear understanding of liquid penetrat inspection and magnetic particle inspection.
3. The basics of Eddy Current Testing.
4. View and interpret radiographs, utilize the various principles of radiography for different components of different shapes
5. The knowledge of acoustic emission for NDT and the instrumentation used for NDT
6. The knowledge of latest research, developments and trends in NDT

Unit-I

Liquid Penetrate inspection: Principle of penetrate inspection, characteristics of a penetrate, water washable system, post emulsification system, solvent removable system, surface preparation and cleaning, penetrate application, development, advantages, limitations, and applications.

Magnetic Particle Inspection: Principle, magnetization methods, continuous and residual methods, sensitivities, demagnetization, Advantages, Limitations, and Applications.

Unit-II:

Eddy Current Testing: Principle, lift-off factor, and edge effect, skin effect, inspection frequency, coil arrangements, inspection probes, types of circuits, reference pieces, phase analysis, display methods 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, inspection techniques, identification of defects, immersion testing, sensitivity and calibration. Reference standards, surface conditions, applications

Unit-IV

Radiography: Principle and uses of radiography, limitation principle, radiation sources, production of X-rays, X-ray spectra, attenuation of radiation, shadow formation enlargement and distortion, radiographic film and paper, inspection of simple and complex shapes, radiation hazard, protection against radiation.

Unit-V

Acoustic Emission: physical principles, sources of emission, instrumentation and applications.

Other NDT Techniques: Neuron radiography, laser induced ultrasonics, surface analysis, and thermography.

Suggested Reading:

1. Barry Hull & Vernon John, '*Non-Destructive Testing*' , 1988.
2. Non-Destructive examination and quality control, ASM International, Vol.17, 9th edition 1989
3. J. Prasad and C.G.K. Nair, Non-Destructive Test and evaluation of materials, Tata McGraw-Hill Education, 2nd edition 2011
4. B. Raj, T. Jayakumar and M. Thavasimuth, Practical Non-Destructive Testing, Alpha Science International Limited, 3rd edition 2002
5. T. Rangachari, J. Prasad and B.N.S. Murthy, Treatise on Non-Destructive Testing and Evaluation, Navbharath enterprises, Vol.3, 1983.

Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Academic Year

Code: PC822PE

TOTAL QUALITY MANAGEMENT

(Professional Elective-VI)

Credits: 3

Instruction: 3 periods per week *Duration of SEE: 3 hours*

CIE: 30 marks *SEE: 70 marks*

Objectives:

1. The essence of total quality management in design and manufacturing a product
2. The a variety of principles and concepts of total quality management
3. Over view of total quality management
4. The various technical tools of quality like control charts ,QFD POKA ,YOKA etc---
5. To be aware of international/national Quality awards and Quality systems organizing.

Outcomes:

1. Student gain the knowledge and importance of TQM, types leaderships theories and best practices in TQM and know the Quality environment of the organization , Apply TQM techniques in engineering applications
2. An over view of Implementation of different types of quality management philosophies and quality circle concept, impact of Taguchi methods in TQM.
3. Use statistical techniques in TQM.
4. Application of tools and methods for quality management in TQM.
5. Concept s of TQM Systems implementation and IS/ISO 90004:2000 discussed .

Unit-I

Introduction to quality management: Definition and framework of TQM, benefits, awareness and obstacles. Quality statements – vision, mission and policy statements. Customer perception of quality, Translating needs into requirements, Customer retention, cost of quality.

Unit-II:

Quality management philosophies: Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle.

Unit-III

Statistical process control, capability and Reliability: Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributes. Process capability – meaning, significance. Reliability– definitions, reliability in series and parallel systems, product life characteristics curve.

Unit-IV

Tools and methods for quality management: Quality functions development (QFD) –House of quality (HOQ), building a HOQ, QFD process. POKA YOKE, Management tools for quality improvement, Juran's improvement programme, Tools for process improvement.

Unit-V

Quality systems organizing and implementation: Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation,

empowerment, recognition and reward.

Suggested Reading:

1. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002.
2. Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education (First Indian Reprints 2004).
3. L.Suganthi etal, Total Quality Management, PHI Learning Pvt. Ltd., New Delhi,2012
4. P.N.Mukharjee, Total Quality Management, PHI Learning Pvt. Ltd., New Delhi,2010
5. Sunil Sharma, Total Engineering Quality Management, MacMillan India Ltd, New Delhi, 2003

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Code: PC823PE

ENERGY CONSERVATION AND MANAGEMENT

(Professional Elective-VI)

Credits: 3

Instruction: 3 periods per week *Duration of SEE: 3 hours*

CIE: 30 marks *SEE: 70 marks*

Objectives:

1. To learn about energy conservation.
2. To understand sources of loss of power in energy conversion.
3. To understand Procedure for Comprehensive Energy Conservation Planning.
4. To understand Industrial energy conservation methods.

Outcomes:

On successful completion of this course, the student will be able to

1. Understand different forms of energy.
2. Calculate the amount of heat energy available.
3. Understand the industry energy conservation modeling.
4. Understand methodology for forecasting industrial energy supply and demand.

Unit-I

Definition, Principles of Energy Conservation - Maximum Thermodynamic efficiency. Maximum Cost - effectiveness in energy use. Various forms of energy - Heat Mechanical. Electrical energy and Chemical energy. Identification of potential sources of energy losses - Transportation, operation and conversion from one from to another.

Unit-II:

Heat energy and storage - Media of transport of heat energy - steam, oil and flue gases. Calculation of steam quality. Calculation of amount of heat energy available. Recuperators. Constructional details, Selection of materials to store heat energy. Concept of power. Modes of mechanical energy transport - Gears, pulleys, belts, shafts etc., Calculation of power. Sources of loss of power in energy conversion into electricity, potential energy (i.e., pumps).

Unit-III

Chemical energy - combustion of fuels - petrol, diesel and coal. Loss due to quality of fuel, conversion into other form of energy - boilers, I.C. engines. Calculation related to losses. Electrical energy - Working principle of motors and generators. Calculation of efficiency of generators. Losses during transmission and energy conversion - into mechanical energy, thermal energy. Calculation of effecting parameters.

Unit-IV

Procedure for Comprehensive Energy Conservation Planning (CECP) -Specifying targets, identifying energy in-efficient facilities. Synthesize evaluation and optimization of alternative conservation measures in view of organization costs. Flow chart of organization's functions. Collection of accountable data. Application of CECP method. An example.

Unit-V

Industrial energy conservation modeling - Methodology - Definition of production

system - A primary copper production system, Model construction - Mathematical Programming. Market penetration, Structure of energy conservation model. Data preparation - coefficients needed in a model, Unit production cost and unit energy requirements. Model exercise, verification and validation. Methodology for forecasting Industrial Energy Supply and Demand.

Suggested Reading:

1. Gottschalk C.M., "*Industrial Energy Conservation*", John Wiley & Sons, 1996.
2. Chaturvedi P., and Joshi S., "*Strategy for Energy Conservation in India*", Concept PublishingCo., New Delhi, 1997.
3. Sharna and Venkata Sebhaiah, "Energy *management and conservation*".
4. Dr. Sanjeevsingh, Umesh Rathore, "*Energy management*", Edition 2019.
5. Mrs. P Nagaveni, Dr. A Amudha, Dr. M.Sivaramkumar and Mr. N. Prasanna, "*Energy management and Energy conservation*".

Course Code	Course Title						Core / Elective
OE801CE	**ROAD SAFETY ENGINEERING**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

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

Course Outcomes:

After completing this course, the student will be able to

1. Understand the fundamentals of traffic safety analysis
2. Analyze Accident data
3. Remember the concepts of road safety in urban transport
4. Apply crash reduction techniques
5. Design of urban Infrastructure considering safety aspects.

UNIT – I

Introduction: Road Safety scenario in India and World, Road Accident Characteristics.

Traffic Safety Analysis: Fundamentals of Traffic Engineering - Basic Characteristics of Motor-Vehicle Traffic, Highway Capacity, Applications of Traffic Control Devices, Design of Parking Facilities, Traffic Engineering Studies; Statistical Methods in Traffic Safety Analysis – Regression Methods, Poisson Distribution, Chi- Squared Distribution, Statistical Comparisons.

UNIT – II

Accident Analysis: Accident Investigations and Risk Management, Collection and Analysis of Accident Data, Condition and Collision Diagram, Causes and Remedies, Traffic Management Measures and Their Influence on Accident Prevention, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness of Safety Design Features, Accident Reconstruction. Application of computer analysis of accident data.

UNIT – III

Road Safety in planning and Geometric Design: Vehicle And Human Characteristics, Road Design and RoadEquipment_s, Redesigning Junctions, Cross Section Improvements, Reconstruction and Rehabilitation of Roads, Road Maintenance, Traffic Control, Vehicle Design and Protective Devices, Post Accident Care.

UNIT – IV

***Traffic Signals & Road signs*:** Traffic Signals, Factors affecting signal design, street lighting, Provisions for NMTVehicles in India, Safety Provisions for Pedestrians & Cyclists, Road Signs and Pavement Markings.

Safety at Construction Site: Safety provisions for workers at construction site, Construction Zone markings, signs.

UNIT – V

Traffic Management safety audit: Traffic Management Systems for Safety, Road Safety Audits and Tools forSafety Management Systems, Road Safety Audit Process, Approach to Safety, Road Safety Improvement Strategies, ITS and Safety.

Suggested Readings:

1. Kadiyali L.R,. *Traffic Engineering and Transport planning*, 9th Edition, Khanna Tech Publishers, 2013.
2. C.E.G. Justo, A. Veeraragavan and S. K. Khanna, *Highway Engineering*, 10th Edition, Nem Chand Publishers, 2017.
3. Donald Drew, *Traffic Flow Theory Chapter 14 in Differential Equation Models*, Springer, 1983
4. C. Jotinkhisty and B. Kent Lall, *Transportation Engineering – An Introduction, 3rd Edition, Pearson publications, 2017*
5. Rune Elvik, Alena Hoye, TrulsVaa, Michael Sorenson, *Handbook of Road Safety measures, second Edition, Emerald Publishing, 2009.*
6. Highway Research Programme (NCHRP) Synthesis 336.*A synthesis of Highway Research Board, Washington D.C, 2016*.

Course Code	Course Title						Core / Elective
OE801CS	**FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- Cover various paradigms that come under the broad umbrella of AI.
- To understand various key paradigms for machine learning approaches
- To familiarize with the mathematical and statistical techniques used in machine learning.
- To understand and differentiate among various machine learning techniques

Course Outcomes:

After completing this course, the student will be able to

1. Develop an understanding of modern concepts in AI and where they can be used
2. Design, implement and apply novel AI techniques based on emerging real-world requirements
3. To formulate a machine learning problem
4. Select an appropriate pattern analysis tool for analyzing data in a given feature space.
5. Apply pattern recognition and machine learning techniques such as classification and feature selection to practical applications and detect patterns in the data.
6. Design and program efficient algorithms related to recent machine learning techniques, train models, conduct experiments, and develop real-world ML-based applications and products

UNIT-I:

INTRODUCTION: Definitions of Artificial Intelligence, Artificial Intelligence Problems, Topics of Artificial Intelligence, Timelines of Artificial Intelligence, Production Systems, State Space Representation, Branches of Artificial Intelligence, Applications of Artificial Intelligence,

UNIT-II:

HEURISTIC SEARCH TECHNIQUES: Generate-and-Test , Hill Climbing, Search Techniques, Problem Reduction, Constraints Satisfaction, Means-ends Analysis

KNOWLEDGE REPRESENTATION: Knowledge Management, Types of Knowledge, Knowledge Representation, Approaches to Knowledge Representation, Issues in Knowledge Representation, Knowledge Base

UNIT-III:

LEARNING: Types of Learning, Machine Learning, Intelligent Agents

CLUSTERING: k-Means Clustering, Fuzzy Clustering, Hierarchical Clustering, Cluster Similarity, Case Studies,

UNIT-IV:

STATISTICAL LEARNING: Hidden Markov Models, Linear Classifiers, Quadratic Classifiers, Decision Trees, Bayesian Networks, Case Studies,

ARTIFICIAL NEURAL NETS: ANN Basics, ANN—Learning Process, Types of Networks, Perceptron, RBF Networks, ANN Summary, Case Studies

UNIT-V:

SUPERVISED LEARNING: Support Vector Machines, Inductive Logic Programming, Case-based Reasoning, Ensemble Classifiers, Nearest Neighbourhood, Fuzzy Network, Case Studies,

UNSUPERVISED LEARNING: Expectation Maximization, Self organizing maps, Adaptive resonance theory, Case studies

Suggested Readings:

1. Vinod Chandra S.S and AnandHareendran S , –Artificila Intelligence and Machine Learning ‖, PHI , 2014
2. PrashantKikani, –Demystifying Artificial intelligence: Simplified AI and Machine Learning concepts for Everyone‖, January 2021, BPB publication
3. Dr. Nilakshi Jain , ―Artificial Intelligence, As per AICTE: Making a System Intelligent‖ January 2019, WILEY India
4. LavikaGoel , –Artificial Intelligence: Concepts and Applications‖ January 2021, WILEY India

Course Code	Course Title						Core / Elective
OE801EE	**SMART BUILDING SYSTEMS**						**OE -III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**		**-**	**30**	**70**	**3**

Course Objectives:

- To understand the basic blocks of Building Management System.
- To design various sub systems (or modular system) of building automation
- To integrate all the sub systems

Course Outcomes:

Student will be able to

- Describe the basic blocks and systems for building automation
- Use different subsystems for building automation and integrate them
- Understand basic blocks and systems for building automation
- Design different systems for building automation and integrate those systems

UNIT – I

Introduction: Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS.

UNIT – II

Fire Alarm (FA) System: concept of fire, Fire modes, History, Components, and Principles of Operation. Different fire sensors, smoke detectors and their types, Fire control panels, design considerations for the FA system. Field Components, Panel Components, Applications. Types of FAS Architectures, Examples. Classification of FAS loops, Examples. FAS Design procedure in brief, NFPA 72A, BS 5839, IS, Concept of IP enabled fire & alarm system, design aspects and components of PA system.

UNIT – III

Access Control System: Access Components, Access control system Design.

CCTV: Camera Operation & types, Camera Selection Criteria, Camera Applications, DVR Based system, DVM, Network design, Storage design. Components of CCTV system like cameras, types of lenses, typical types of cables, controlling system. CCTV Applications.

UNIT – IV

Security Systems Fundamentals: Introduction to Security Systems, Concepts.

Perimeter Intrusion: Concept, Components, Technology, Advanced Applications. Security system design for verticals. concept of automation in access control system for safety, Physical security system with components, RFID enabled access control with components, Computer system access control –DAC, MAC, RBAC.

EPBX System & BMS subsystem integration: Design consideration of EPBX system and its components, integration of all the above systems to design BMS.

UNIT – V

Energy Management: Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples.

Building Management System: IBMS (HVAC, Fire &Securi-ty) project cycle, Project steps BMS, Advantages & Applications of BMS, IBMS Architecture, Normal & Emergency operation, Advantages of BMS.

Suggested Readings:

1. Jim Sinopoli, *Smart Buildings*, Butterworth-Heinemann imprint of Elsevier,2nd ed., 2010.
2. Reinhold A. Carlson, Robert A. Di Giandomenico, *Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs)*, R.S. Means Company Publishing, 1991.
3. Albert Ting-Pat So, WaiLok Chan, Kluwer, *Intelligent Building Systems*, Academic publisher,3rd ed., 2012.
4. Robert Gagnon, *Design of Special Hazards and Fire Alarm Systems*, Thomson Delmar Learning; 2nd edition, 2007.
5. Levenhagen, John I.Spethmann, Donald H, *HVAC Controls and Systems*, McGraw-Hill Pub.
6. Hordeski, Michael F, *HVAC Control in the New Millennium*, Fairmont press, 2001.
7. Bela G. Liptak, *Process Control-Instrument Engineers Handbook*, Chilton book co.

Course Code	Course Title						Core / Elective
OE 802 EE	**PROGRAMMABLE LOGIC CONTROLLERS**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To be able to understand basics of Programmable logic controllers, basic programming of PLC.
- To make the students to understand the Functions and applications of PLC

Course Outcomes

At the end of the course students will be able to

1. Develop PLC programs for industrial applications.
2. Acquire the knowledge of PLC counter functions and PLC Arithmetic functions and data handlingfunctions.

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: Programming on/off inputs to produce on/off outputs - PLC input instructions - Outputs - 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.

UNIT-III

Basic PLC Functions: General Characteristics of Registers - Module addressing - Holding registers - Input registers - output registers - PLC timer functions - examples of timer functions. Industrial applications - PLC counter functions.

UNIT-IV

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 and BCD-Hexadecimals numbering systems.

UNIT-V

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.

Suggested Reading:

1. John W. Weff, Ronald A. Reis, Programmable Logic Controllers, Prentice Hall of India Private Limited, Fifth edition, 2003.
2. Frank D. Petruzella, *Programmable Logic Controllers*, 5th Edition, Mc-Graw Hill, 2019.

Course Code	Course Title						Core / Elective
OE 801 EC	**PRINCIPLES OF ELECTRONIC COMMUNICATIONS**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	**Credits**
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

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

Course Outcomes

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

UNIT – I

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

UNIT – II

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

UNIT – III

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

UNIT – IV

Telecommunication Systems: Telephones, Telephone system, Paging systems, Internet Telephony.
Optical Communications: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT – V

Wireless Communications: Evolution of Wireless Systems: AMPS, GSM, CDMA, WCDMA, OFDM. Current

Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

Suggested Readings:

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

Course Code	Course Title						Core / Elective
OE 801 IT	**SOFTWARE ENGINEERING**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

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

Course Outcomes:

After completing this course, the student will be able to

1. Acquired working knowledge of alternative approaches and techniques for each phase ofsoftware development
2. Judge an appropriate process model(s) assessing software project attributes and analyze necessary requirements for project development eventually composing SRS.
3. Creation of visual models to describe (non-) algorithmic solutions for projects using various design principles.
4. Acquire skills necessary as an independent or as part of a team for architecting a complete software project by identifying solutions for recurring problems exerting knowledge on patterns.

UNIT – I

Introduction to Software Engineering:

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

Process Models: Prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

An Agile view of Process: Introduction to Agility and Agile Process, Agile Process Models

UNIT – II

Software Engineering Principles: SE Principles, Communication Principles, Planning Principles, Modeling Principles, Construction Principles, Deployment.

System Engineering: Computer-based Systems, The System Engineering Hierarchy, Business Process Engineering, Product Engineering, System Modeling.

Requirements Engineering: A Bridge to Design and Construction, Requirements Engineering Tasks, Initiating Requirements Engineering Process, Eliciting Requirements, Developing Use-Cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements.

UNIT – III

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

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

UNIT – IV

Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design. ***Modeling Component-Level Design:*** Definition of Component, Designing Class-based Components, Conducting Component-level Design, Object Constraint Language, Designing Conventional Components. ***Performing User Interface Design:*** The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT – V

Testing: Strategies: A Strategic Approach to Conventional Software Testing, Test Strategies for O-O Software.

Tactics: Software Testing Fundamentals, Black-box and White-box Testing, Basis Path Testing, Control Structure Testing, O-O Testing Methods.

Debugging: Debugging Techniques, The Art of Debugging.

Product Metrics: A Framework for Product Metrics, Metrics for each phase of software development.

Software Quality: Definition, ***Quality Assurance:*** Basic Elements, Formal Approaches, Statistical Software Quality Assurance, Software Reliability, ISO9000 Quality Standards, SQA Plan.

Suggested Readings:

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

Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Academic Year

Course Code	Course Title						Core / Elective
OE 801 ME	**3D PRINTING TECHNOLOGIES**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To understand the fundamental concepts of 3D Printing, its advantages and limitations.
- To know the working principle, advantages, disadvantages and applications of liquid,solid and Powder based 3D Printing Technologies.
- To know diversified applications of 3D Printing Technologies.

Course Outcomes:

After completing this course, the student will be able to

1. Interpret the features of 3D Printing and compare it with conventional methods.
2. Illustrate the working principle of liquid, solid and powder-based 3D Printing Technologies.
3. Apply the knowledge of various 3D Printing technologies for developing Innovativeapplications.

Unit-I

Introduction: Prototyping fundamentals, Historical development, Fundamentals of 3D Printing, Advantages and Limitations of 3D Printing, commonly used Terms, 3D Printing Process Chain, 3D Modeling, Data conversion and Transmission, Checking and Preparing, Building, Post-processing, RP Data formats, Classification of 3D printing processes, Fundamental Automated Processes, Distinction between 3D Printing and Conventional Machining Processes.

Unit-II

Liquid-based 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. Polyjet:Models and specifications, Process, working principle, 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 System: 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. Multi-Jet Modelling (MJM): Models and specifications, Process, Working principle, Applications, Advantages and Disadvantages, Case studies.

Unit-IV

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

Unit-V

Applications of 3D Printing : Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Electronic Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture, Pattern for investment and vacuum casting, Medical Models and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, and Web Based Rapid Prototyping Systems.

Suggested Reading:

1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principlesand Applications" Fifth Edition, World scientific
2. Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing" Springer, Second Edition,2010.
3. Frank W.Liou, "Rapid Prototyping & Engineering Applications"- CRC Press, Taylor &Francis Group, 2011.
4. Rafiq Noorani, "Rapid Prototyping: Principles and Applications in Manufacturing", JohnWiley & Sons, 2006.

Course Code	Course Title						Core / Elective
OE 801 AE	**ELEMENTS OF ELECTRIC AND HYBRID VEHICLE TECHNOLOGY**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To understand the hybrid vehicle technology
- To know the energy storage requirements and analyze the hybridization of different storage devices.
- To understand the configuration of various electric propulsion units.
- To know the different hybrid drives and the concept of electric drive trains.

Course Outcomes:

After completing this course, the student will be able to

1. Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
2. Discuss different energy storage technologies used for hybrid electric vehicles and their control.
3. Analyze various electric drives suitable for hybrid electric vehicles.
4. Explain plug – in hybrid electric vehicle architecture, design and component sizing and the power electronics devices used in hybrid electric vehicles.
5. Demonstrate different configurations of electric vehicles and its components, hybrid vehicle configuration by different techniques, sizing of components and design optimization and energy management.

Unit - I

Introduction: Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies Electric vehicles; configuration of EVs, performance, traction motor characteristics, tractive effort and transmission requirements.

Unit- II

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.

Unit - III

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives

Unit - IV

Hybrid Drives: Introduction, features, functional classification, start/stop system, mild hybrid, full hybrid, plug-in-hybrid, batteries for hybrid vehicles, and optimization of hybrid configurations. Changing modes for conductive charging.

Unit - V

Hybrid Electric Vehicles (HEVs) And Drive Structures: Concept of electric drive train, architecture of hybrid electric drive train, series hybrid drive, parallel hybrid electrical drive train.
Electric and Hybrid Vehicles - Case Studies: Honda Insight, Chevrolet Volt, GM EV1, Toyota RAV 4 EV and Ford; Think City

Suggested Reading

1. Iqbal Husain, "Electic and Hybrid vehicles Design Fundamentals" , CRC Press, second edition 2013
2. James Larminie, John Lowry, "Electric vehicle techonology Explained" 2nd Ed.,Wiley 2012
3. Vehicular Electrical Power Systems – Emadi, Ehasni, Mercel (Marcel Dekker)
4. Electric and Hybrid vehicles – Pistoia (Elsevier)
5. Fuel cells principles and applications - B.Vishwanath, M. AuliceScibion (University Press)
6. Electrical vehicle machine and drives – K.T.Chau (Wiley).

Code: PW703PE

PROJECT-II
(Project Work-II)
Credits: 3

Instruction: 6 periods per week *Duration of SEE: --*
CIE: 50 marks *SEE: 70 marks*

Objectives:

1. To enhance practical and professional skills.
2. To familiarize tools and techniques of systematic literature survey and documentation
3. To expose the students to industry practices and team work.
4. 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 the 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:

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 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 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 guid