ILOE – Odd Semester

Branch	Course Name	Except
Civil	Environmental Pollution	Civil
Civil	Applied Finite Element Analysis	Civil
E&TC	Broadband Communication	E&TC
Computer and IT	Intermediate Programming Concepts and Tools	Computer and IT
Electrical	1. Control Systems Engineering 2. Electrical Installation and Practices	Electrical
Mathematics	Complex Analysis	No backlog of any Mathematics courses
Instrumentation	Industrial Automation	Instrumentation
Mechanical	1. Robotics 2. Air conditioning	Mechanical
Metallurgy	Selection of Materials and Processes	Metallurgy
Production	Operations Research	Production
Production	Operations Efficiency	Production
Applied Science	Polymer Technology	All Branches

CE (ILOE) Environmental Pollution

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
Test 1 and 2 – 20 Marks each
End-Sem Exam- 60 Marks.

Pre-requisite: No

Course Outcomes: After completion of the course Student will be able to

A. Identify local and global effects of pollution and suggest control measures.
B. Identify atmospheric stability conditions and relate them to transport of air pollutants & design stack under given conditions
C. Collect data and analyze the problem of noise, odor pollution & solid waste management
D. Understand importance & preparation stages of Environmental Impact Assessment
E. Determine the flow diagram of water and waste water treatment process and decide domestic wastewater treatment processes.

Unit I **[05 hrs]**

Environment and its interaction with human activities –
Environmental imbalances, Factors Contributing to Urban Pollution in India.
Air pollution- Definition, sources of air pollution, types and classification of air pollutants, Primary and Secondary air pollutants and their importance, Atmospheric stability, mixing heights, **Control of Pollution:** By process modification, Change of raw materials, Fuels, process equipment and process operation by use of air pollution control equipments, For particulate pollutants, Air Pollution control by using Equipments, **Land use planning:** As a method of air pollution control

Unit II **[05Hrs]**

A) Chemistry of air pollution: Photochemistry of air pollution, Photochemical smog reactions involved in its formation, Factors influencing its reactions.
B) Effects of Air Pollution: Effects on man, animals, vegetation and property, Economics of loss due to pollution, Episodes, Global effects of air pollution

Unit III **[07 hrs]**

Meteorological Aspects:
Parameters influencing air pollution, measurement of parameters plume behaviour, transport, and diffusion. Formulae for stack heights, Gaussian diffusion models for finding ground level concentration. Design problems of height of chimney and ground level concentration

Unit IV **[07 hrs]**

A) Solid waste Management
Sources, classification issues related to SWM, treatment techniques.
B) Odors: Sources, measurement and control

Unit V **[07 hrs]**

A) Noise Pollution Sources, Noise characteristics, measurement of noise, Effects of noise, Control of noise.

B) Environmental Impact Assessment:

Definition, Broad Goals, Objectives, Phases in EIA, Contents of Application form, Advantages & Disadvantages of EIA, Environmental management plan, Environmental Impact of Industries, Urbanization and Agricultural activities. Case studies

Unit VI **[09 hrs]**

Water and Wastewater treatment

Sources of water, Physical, Chemical and biological quality of water, Standards for drinking water, flow diagram of water treatment process,

Classification of wastewater treatment, Aerobic and anaerobic treatment, Biological and chemical treatment, flow diagram of wastewater treatment process, Centralized sewage treatment systems, Consequences of centralized wastewater treatment, Objectives of small and decentralized wastewater treatment systems Advantages of Decentralized Wastewater Treatment, Applications of decentralized wastewater management

Reference books

- M.N. Rao , Air Pollution,Tata McGraw hill 1989 edition
- Perkins , Air Pollution, McGraw-Hill Edition 2000
- Muralikrishna, K. V. S. G., Air Pollution and Control, Kaushal & Co., Kakinada, AP, 1995.
- Canter, L., Environmental Impact Assessment. Second edition. McGraw Hill, 1996.
- G. J. Gau, C. D. Wooten, Environment Impact Assessment - Analysis Handbook, McGraw Hill.
- Manual on sewerage & sewage Treatment published by Ministry of Urban Development Govt. of India Msy-2000. 35 PDOP-4-59-85-97 ...Ministry of Urban development
- Metcalf and Eddy, Wastewater Engineering, Tata McGraw Hill, 1996

CE (ILOE) Applied Finite Element Analysis

Teaching Scheme
Lectures : 3 hrs / week

Examination Scheme
Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

Students will be able to:

- Solve Ordinary differential equations using Finite Element Method.
- Solve simple Engineering problems using Finite Element Analysis.
- Use the commercial Finite Element software to build Finite Element models and solve a selected range of engineering problems.

Contents:

Unit I: Introduction
Introduction to Finite Element Method, General Procedure of Finite Element Analysis, History of the Finite element Method, Examples of Finite Element Analysis [6 hrs]

Unit II: Truss Structures
Bar Element, Nodal Equilibrium Equations, Element Transformation, Assembly of Global Stiffness Matrix, Boundary conditions, Element Strain and Stress. [6 hrs]

Unit III: Flexure Elements
Elementary Beam Theory, Beam Element, Beam Element Stiffness Matrix, Element Load Vector, Flexure Element with Axial Loading. [6 hrs]

Unit IV: Method of Weighted Residuals
Method of Weighted Residuals, The Galerkin finite Element Method, Application of Galerkin's Method to Structural Elements. [7 hrs]

Unit V: Interpolation Functions
Compatibility and Completeness Requirements, Polynomial forms, Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Isoparametric Formulation, Axi-symmetric elements, Numerical Integration, Gaussian Quadrature. [8 hrs]

Unit VI: Applications in Solid Mechanics
Plane Stress, Plane Strain, Axi-symmetric Stress analysis, General Three-dimensional Stress Elements, Strain and Stress Computation. [7 hrs]

Reference Books:

- T.R. Chandrupatla and A. D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall Publication, 4/e, 2011.
- D. V. Hutton, "Fundamentals of Finite Element Analysis", McGraw Hill Publication, 10/e, Pearson Publication, 2017.
- P. Seshu, " Textbook of Finite Element Analysis", Tata McGraw Hill Publishing Company Limited.,2004
- D.L. Logan , "A First Course in the Finite Element Method", Cengage Publications , 2012.

Broadband Communication

Teaching Scheme:
Lectures: 3 hrs/week

Examination Scheme:
T1 and T2: 20 Marks each End-Sem Exam: 60 marks

Unit 1 (06)

Mobile Communication: Mobile Communication principles, Architecture of GSM, Introduction to 2G to 4G systems such as GSM, HSCSD, GPRS, EDGE etc, principles of CDMA.

Unit 2 (06)

Satellite Communication: Satellite technology evolution, LEO, MEO, GEO satellites and their special services, orbital equations, link budget for C-band satellite, impact of satellite in Indian scenario

Unit 3 (06)

Fixed Wireless Systems: Microwave links, Private unlicensed links (Spread spectrum), MMDS (Multi-channel Multi-point distribution Service), LMDS (Local multipoint Distribution Service) (MMDS and LMDS are Video and Internet signal distribution services by wireless means.)

Unit 4 (06)

Wi-Fi and Wi-MAX technologies: introduction to Wi-Fi and Wi-MAX, Principles and parameters for Wireless LAN (IEEE 802.11 standards), operating principles for Wi-MAX (IEEE 802.16 standard), Comparison of Wi-Fi and Wi-MAX.

Unit 5 (06)

Optical Fiber Communication: Principles of optical fiber communication, significant features and advantages of optical fiber communication, Recent trend - FTTH (Fiber-To-The-Home) System.

Unit 6 (04)

Quality-of-Service (QoS) in Broadband: QoS issues in broadband communication, A case study of broadband service regulations for maintaining QoS by telecom regulatory bodies such as TRAI.

Text Books:

1. Theodore S. Rappaport, "Wireless Communications – Principles and Practice", PHI.
2. Louis E. Frenzel, "Principles of Electronic Communication Systems", Tata McGraw Hill.

Reference Books:

1. Timothy Pratt and Others, "Satellite Communications", Wiley India.
2. Recent QoS regulations released by TRAI (available on website of TRAI).

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Compare cellular (mobile) communication systems from 2G to 4G and their impact on the society.
- Visualize the architecture of satellite systems as a means

of broadband communication and also the Indian scenario in the satellite area.

- State key features and operating principles of Wi-Fi and Wi-MAX systems.
- State key features of optical fiber communication and its advantages, and appreciate the revolution brought by the systems such as FTTH.

OPEN ELECTIVE : INTERMEDIATE PROGRAMMING CONCEPTS AND TOOLS

TeachingScheme
Lectures : 3hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignment/Quizzes – 40 marks
End Sem Exam - 60 marks

Unit 1 (2 Hrs)

Introduction:
Role of programming, need to study programming, applications of computer programming in industry.
Types of programming languages and paradigms.

Unit 2 (8Hrs)

A review of fundamentals:
What is algorithm, flowchart, and binary numbers. Straight line code,Expressions and their types, Decisions and conditional statements, Loops. Input-Output statements.
Procedures: Procedure call and return, recursive subprogram, Different parameter passing methods, Scope, lifetime and visibility, Storage management (static and Dynamic), Exceptions and exception handling.
Modularity and reusability using procedures. Use of libaries and header files.
Complex data types and moving towards object-orientation.

Unit 3 (6 Hrs)

Object Oriented Programming: Design Principles: Objects, classes, Messages and methods, Basics of Implementation of Object – oriented Programming.

Unit 4 (6 Hrs)

Object oriented programming with Java/Python/C++: Program structure, Object and class declarations, constructors, inheritance, polymorphism, access specification, interfaces, packages, exception handling, I/O.

Unit 5 (8Hrs)

Introduction to Program Design: Program design philosophies. Design patterns.
Performance Analysis: Introduction to growth of functions and algorithm performance. Different aspects of code performance. Profiling.
Correctness: Pragmatic and theoretical tests for correctness. Good programming practices. Debugging.
Case studies.

Unit 6 **(6 Hrs)**

Introduction to concurrent programming: Basic concepts of Concurrent Programming: processes, synchronization primitives, safety and live ness properties, Parallelism in Hardware, streams, concurrency as interleaving, safe access to shared data.

Text Books:

- Cornell and Horstman, "Core Java vol 1'', Prentice Hall
- Herbert Schilt, "JAVA Complete Reference", 7thEdition, Tata McGraw Hill, ISBN: 9780070636774
- Mark Lutz, "Learning Python", 2ndEdition,O'reilly, ISBN:978-0-596-00281-7
- Stanley B. Lippman, JoséeLajoie, Barbara E. Moo, "C++ Primer", 3rdEdition, Addison Wesley Professional,ISBN-10: 0201824701

References:

- Sebesta R., "Concepts Of Programming Languages", 4th Edition, Pearson Education, ISBN-81-7808-161-X
- Ghezzi C, Milano P., Jazayeri M., "Programming Languages Concepts", 3rd Edition, John Wiley and Sons Pvt. Ltd (WSE), ISBN-0195113063
- M. Ben Ari, "Principles of Concurrent Programming, 1989
- Eckel B., "Thinking in Java", 3rd Edition, Pearson Education
- Seirra, Freeman, Bates "Head first design patterns''. Oreilly
- Steve McConnell, "Code Complete''. Microsoft Programming Series.

SEMESTER VII

ILOE

Control System Engineering

Teaching Scheme:
Lectures: 3 hrs/week
Tutorial : 0 hrs/week

Examination Scheme:
100 marks: Continuous evaluation-
Assignments /Quiz- 40 Marks,
End - Sem Exam – 60 Marks

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

1. Realize role of control in various industrial applications.
2. Understand various control components
3. Use tools root locus and bode plot to analyze the system.
4. Develop sequential control using contactors and relays and PLC

Unit 1 **[06 Hrs]**
Fundamentals of Control System
Introduction to control system , Block diagram of control system, Transfer Function representation of a system. Notion of feedback, open and closed -loop systems. Tracking regulator and process control systems, Linear Mathematical models, concept of poles and zeros Electric Systems, Hydraulic System, Thermal System, Pneumatic System , Electromechanical system, Transfer function and role of control in such systems

Unit 2 **[06 Hrs]**
Control System Components
Servo components: Error detectors, Potentiometer, synchros, optical rotary encoders, DC and AC Servomotors, stepper motor, gear trains, A C and DC tacho-generators, contactors, relays,

Unit 3 **[06 Hrs]**
Time Domain Analysis
Transient response of first and second order system, Time domain specification, Steady state error and static error constants. Concept of stability. Routh's stability criteria , Root Locus for system analysis

Unit 4 **[06 Hrs]**
Frequency Domain Analysis
Concept of Frequency response, gain and phase margin, Bode plot and its use for frequency domain analysis

Unit 5 **[06 Hrs]**

PID Controller

Introduction to PID control, tuning of PID gains by different methods. Use of PID controllers for various Industrial applications

Unit 6 **[08 Hrs]**

Programmable logic controller (PLC)

Basics of PLC and its application in industrial automations, process control, number systems, codes, components and systems, ladder logic design, programming, memory system and analog and discrete Input / Output system, practical control system implementation

Text Books:

- I J Nagrath and M. Gopal ,"Control system Engineering", Wiley Eastern Ltd, (3rd edition), 2000.
- Norman Nise ,"Control system Engineering", John-Willey (3rd edition,),2000.

Reference Books:

- John J. D"Azzo, C. H. Houpis,"Linear control system analysis and design (conventional and modern)", McGraw Hill International Fourth edition.
- Katsuhiko Ogata, " Modern Control Engineering", Prentice Hall of India Pvt Ltd.
- L.A. Bryan and E. A. Bryan, "Programmable Controllers – Theory and implementation," Second edition, A Industrilal text company publication, USA, 1997.

ELECTRICAL INSTALLATION PRACTICES

Teaching Scheme:
Lectures: 3 hrs/week

Examination Scheme:
100 Marks: Contionuous evaluation
Assignments/ Quiz- 40 marks
End-sem Exam: 60 marks

Unit 1 **[05 hrs]**

Electrical lay out and distribution systems

Introduction to general electric distribution systems, residential buildings, IT sector industry (3-4 types such as sugar, plastic, mechanical, chemical), Various components and their functions, General specification and ratings, top class brands, drawing of electric ciruits, standard symbols, MCC and DCC, design issues for MCC and DCC.

Unit 2 **[08 hrs]**

Differential components in electric systems

Types of wirings, cables, Insulators, Switches, thermal relays, wires, conductors, Types of Energy meters, MCB's and MCCB's, single phase preventer and basic protection equipment, HRC fuses, capacitors for PF correction, earthing of electrical installations.

Unit 3 **[08 hrs]**

Installation of electrical devices

Various types of electric motors, selection of motors for various applications such as fans, pumps, compressors, extruders, lifts, servo drives, heating and cooling of motors, simple industrial control such as multi-speed, star/delta, forward reverse, control circuits.

Unit 4 **[08 hrs]**

Heating and lighting system design

Types of electric heating, types of industrial heaters, installation of heaters, induction heating, different terminology in illumination for different applications, standard procedure, energy conversion options such as CFL, LED lamps etc.

Unit 5 **[08 hrs]**

Typical installations

Installation of A. C.'s, UPS, inverters, D.G. sets, estimating the requirements, sizing the device, electrical system requirements, typical diagrams, AMF panel, types of UPS- on line and off line

Unit 6 **[08 hrs]**

Principle of contracting

Purchasing techniques, spot quotations, floating enquiry, typical example of quotation form, preparation of comparative statement, analysis of comparative statement, tender types(Single tender, Open tender), Earnest money, Security deposit, various steps involved in complete purchase, typical order formats, various criteria for selecting the supply, general considerations in order for procedures to be allowed for submitting the tenders and quotations.

Text Books:

- Uppal S.L., Garg S.C.,"Electrical wiring, estimation and costing", Khanna publishers, New Delhi, Sixth edition 2009.
- Surjit Singh,"Electrical Estimating and Costing", Dhanpat rai and sons Reprint 2008.
- Raina K. B., Bhattacharya S. K., "Electrical Design Estimating and Costing", New age International Publishers Reprint 2009.

College of Engineering, Pune-5.
Department of Mathematics
(MA) Complex Analysis
Final Year B. Tech. (ILOE) Semester VII

Teaching Scheme
Lectures : 3 hrs / week

Examination Scheme
Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Objectives : . Many engineering problems may be treated and solved by the methods involving complex numbers and complex functions. Apart from being interesting in its own right, investigating complex numbers and complex analytic functions offers deep insights into many practical problems related to electric circuits, mechanical vibrating systems, heat conduction , fluid flow, electrostatics etc. The aim of this course is to expose the students to basic ideas of Complex Analysis and to give them the glimpse of some physical applications.

Unit I : Complex Numbers and Functions

Review of complex numbers and their geometry, Functions of complex variables, Limit, Continuity and Derivatives of functions of complex variables, Analytic functions, Cauchy-Riemann Equations (with proof). **[6 Hrs]**

Unit II: Elementary Functions and Mapping By Elementary Functions

Exponential function, Trigonometric and hyperbolic functions, Logarithmic function, Inverse Trigonometric Functions, Transformation of elementary functions, The linear fractional Transformation, Successive transformations. **[8 Hrs]**

Unit III : Complex Integration

Line Integral, Cauchy Integral Theorem, Simply and multiply connected domains, Indefinite integrals, Cauchy Integral formula, Derivatives of Analytic Functions. **[7 Hrs]**

Unit IV : Power series Expansions of Analytic functions

Review of sequences, series and convergence tests, Power Series, Power Series Expansions of Analytic Functions, Taylor Series(Taylor's Theorem with Proof), Laurent series(Laurent's Theorem without Proof), Multiplication, Division , Integration and Differentiation of Power Series.

[8 Hrs]

Unit V : Residues and Poles

Singularities and Zeros of Analytic Functions, Residues, The Residue Theorem, Evaluation of Improper Real Integrals. **[6 Hrs]**

Unit VI : Conformal Mapping and Its Applications

Conformal Mapping, Electrostatic fields, Heat Problems, Two Dimensional Fluid flow.**[5 Hrs]**

Text Book :

- Complex Variables and Applications by R. V. Churchill and J. W. Brown (8^{th} Ed.) (Tata McGraw-Hill)

Reference Books :

- Advanced Engineering Mathematics by Erwin Kreyszig (9^{th} Ed.) (Wiley Publication.)
- Complex Analysis for Mathematics and Engineering by J. H. Mathews and R. W. Howell (5^{th} Ed.) (Norosa Publishing House)
- Introduction to Complex Analysis by H. A. Priestley, (2^{nd} Ed.) Indian Edition (Oxford University Press)
- Complex Variables- Introduction and Applications, by M. J. Ablowitz and A. S. Fokas, Cambridge University Press, 1998
- Theory of Functions of a Complex Variable by Shanti Narayan and P. K. Mittal(2^{nd} Ed.) (S. Chand Publication)

Outcomes:

1. Students should know the basic concepts of Complex Analysis.
2. Students should acquire the basic techniques involved in calculus of functions of complex variables.
3. Students should be able to apply the techniques regarding power series.
4. Students should be able to apply the techniques regarding conformal mappings to various fields.

Semester VII

(IE) Industrial Automation

Teaching Scheme:
Lectures : 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

- Gained knowledge of Industrial Automation basics [PEO5][PO-i]
- Selection of control components for given application [PEO2][PO-c]
- Understanding of contemporary / emerging technology for various applications [PEO2][PO-j]

Unit I: **[6 hours]**

Fundamentals of Process Controls: Introduction and evolution of Automation, Elements of process control loop, concept of process variables, set point, controlled variable, manipulated variable, load variable. Examples of process loops like temperature, flow, level, pressure.

Unit II: **[8 hours]**

Transmitters and Converters: Introduction to transmitters, Types, working principle and block schematic, Need for standardization of signals, current, voltage and pneumatic signal standards, concept of live & dead zero,, 2-wire transmitter, HART, Differential Pressure Transmitter: Types, mounting (Installation), manifolds, calibration setup, Application of DPT for level measurement, Zero elevation, Suppression, Calibration of transmitters, I/P converter, P/I converter working principle and calibration procedure.

Unit III: **[6 hours]**

Control Valves: Necessity and types of valves used in Industries, Construction, Advantages, Disadvantages & applications of Globe: single, double, 3way, angle, Gate, Needle, Diaphragm, Rotary valves, Ball, Butterfly, working principle of pneumatically operated control valve and motorized control valve, Control valve accessories

Unit IV: **[6 hours]**

Programmable Logic Controller (PLC): Necessity and working principle along with block schematic of PLC, Fixed & Modular PLC (Rack, Slot, Grouping), Specifications, manufacturers, Types of Input & Output modules (AI, DI, AO, DO), wiring diagram, Programming languages, Development of ladder for sequencing of motors, tank level control, ON-OFF temperature control.

Unit V: **[8 hours]**

Application of PLC in major Industries: working and automation of pump house, Motor Control Centre (MCC), elevator, reactor, and bottle filling using the ladder diagram. Introduction to SCADA and HMI.

Unit VI: **[6 hours]**

Hierarchical level of automation, Distributed Control System, Plant wide automation, web enabled plants, communication and data transfer issues, wireless technology, advances in process control.

Text Books:

- Andrew and Williams Gulf "Applied Instrumentation in the process Industries", Volume I, CRC Press, 1980
- Garry Dunning, "Programmable Logic Controllers" 3rd Ed, PHI Pub. 2004.
- Control Valve Handbook by ISA.

(ILOE) Robotics

Teaching Scheme:
Lectures : 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Student will be able to

1. learn basic terminologies and concepts associated with Robotics & Automation
2. study various Robotic sub-systems and innovations in Robotics
3. understand hardwares and softwares of robotics to understand working of robots
4. study the associated aspects in Robotics and allied sciences.

Unit I: Introduction

Robot Definitions , three laws, DOF, Misunderstood devices.....etc. , Elements of Robotic Systems i.e. Robot anatomy, Classification, Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device, ..etc,

Automation :- Concept, Need, Principles and Strategies of Automation, Basic Elements of an Automated System

Innovative Robotic Apllications :- Biomimetic Robots, Swarm Robots, Micro & Nano Robots, Surgery Robots, Assisting Robots, Androids & Geminoids....etc. **[5 hrs]**

Unit II: Robot Grippers, Sensors for Robots, Vision Sensors

Robot Grippers:- Types of Grippers , Design aspect for gripper, Force analysis for various basic gripper system.

Sensors for Robots:- Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot.

Vision Sensors :- Vision System Devices, Image acquisition, Masking, Sampling and quantisation, Image Processing Techniques , Noise reduction methods, Edge detection, Segmentation. **[5 hrs]**

Unit III: Drives, Control Systems

Drives:- Types of Drives, Actuators and its selection while designing a robot system. Types of transmission systems,

Control Systems :- Types of Controllers, Introduction to closed loop control

Control Technologies in Automation :- Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms. **[6 hrs]**

Unit IV: Kinematics, Dynamics

Kinematics :- Transformation matrices and their arithmetic, link and joint description, Denavit - Hartenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematics calibration, inverse kinematics, solvability, algebraic and geometrical methods.
Dynamics: - Introduction to Dynamics , Trajectory generations & planning **[7 hrs]**

Unit V : Robot Programming, Programming Languages

Robot Programming :- Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines,
Programming Languages: Introduction to various types such as RAIL and VAL II ...etc, Features of each type and development of languages for recent robot systems.
Artificial Intelligence: - Introduction to Artificial Intelligence, AI techniques, Need and application of AI. **[7 hrs]**

Unit VI: Modeling and Simulation

Modeling and Simulation :- Introduction, need for system Modeling, Building Mathematical Model of a manufacturing Plant, Modern Tools- Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation.
Allied Topics in Robotics:- Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and associated mass, New Trends & recent updates in robotics. Trend of robotisation in industry. **[6 hrs]**

Text Books:

- John J. Craig, "Introduction to Robotics (Mechanics and Control)", Addison-Wesley, 2nd Edition, 2004
- Mikell P. Groover et. Al., "Industrial Robotics : Technology, Programming and Applications", McGraw – Hill International, 1986.
- Shimon Y. Nof ," Handbook of Industrial Robotics" , John Wiley Co, 2001.
- Automation, "Production Systems and Computer Integrated Manufacturing", M.P. Groover, Pearson Education.
- W.P. David, "Industrial Automation", John Wiley and Sons.

Reference Books:

- Richard D. Klafter , Thomas A. Chemielewski, Michael Negin, "Robotic Engineering : An Integrated Approach" , Prentice Hall India, 2002.
- : R.C. Dorf, "Handbook of design, manufacturing & Automation", John Wiley and Sons.

(IOLE) Air Conditioning

Teaching Scheme:
Lectures : 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcome :

At the end of course student should be able to:

1. Interpret the concepts of Psychrometry.
2. Demonstrate and select Air-conditioning systems for various applications.
3. Estimate cooling load for various applications.
4. Design the Air conditioning systems.
   Analyze duct system for a central Air-conditioning system

Unit I: Psychrometry

Introduction, Applications of Air conditioning, Psychrometry, Psychrometry chart, Typical Air-conditioning process, Adiabatic cooling, Sensible heating, Cooling with humidification Process, Heating and Humidification, Adiabatic mixing of air streams, Air washer, Chemical dehumidification (Numerical Treatment). **[10 hrs]**

Unit II: Air-conditioning systems

Introduction ,Classification of Air-conditioning systems, Unitary systems, Central Classification of Air-conditioning systems, Reheat system, Multizone system, Dual Duct system, Variable Air Volume system (VAV) system, All – air and water systems, Unitary Vs Central systems. **[6 hrs]**

Unit III: Cooling Load Estimation

Introduction, Comfort, Human comfort chart, Outside Design conditions, Sources of heat load ,conduction through Exterior structures, Heat gain through glass , infiltration, ventilation, outside air load , heat load from people, Lightning, heat gain from equipment, System heat gain room cooling loads, cooling coil load. **[8 hrs]**

Unit IV : Designing the Air-Conditioning Systems

Psychometric analysis of Air-conditioning systems, Summer air-condition systems provided with Ventilation air, Room sensible heat factor (RSHF). **[6 hrs]**

Unit V : Air-conditioning Components

Cooling coil, Heating coils, Air cleaning devices, Humidifiers, Fan, Air distribution systems. **[5 hrs]**

Unit VI: Duct Design

Introduction , classification ,Duct materials, Continuity equation , Energy equation for pipe flow, total static velocity pressure , Static region , Pressure loss in duct Rectangular sections

equivalent to circular duct. Dynamic losses in duct, Methods of duct design, Duct arrangement systems. **[5 hrs]**

Text Books

- R.J.Dossat, "Principles of Refrigeration", Pearson Education Asia, 2002
- C.P.Arora, "Refrigeration and Air-conditioning", Tata McGraw-Hill, 2017
- Stoecker & Jones, "Refrigeration and Air-conditioning", McGraw Hill Book Company, New York, 1983.
- S.N. Sapali "Refrigeration and Air-conditioning", PHI, 2016

Reference Books

- J.L.Threlkeld, "Thermal Environmental Engineering", Prentice Hall, 1970.
- W.F.Stoecker, "Industrial Refrigeration Handbook", McGraw-Hill, 1998.
- P.C.Koelet, "Industrial Refrigeration: Principles, Design and Applications", Macmillan, 1992
- ASHRAE HANDBOOKS four volume Index 2014-2017
- "Handbook of air-conditioning system design", Carrier Incorporation, McGraw Hill Book Co.,U.S.A, 1965.
- Jones W.P., "Air Conditioning Engineering", Edward Arnold Publishers Ltd., London, 1985.
- Hainer R.W., "Control Systems for Heating, Ventilation and Air-Conditioning", Van Nostrand Reinhold Co., New York, 1984

(MT-17) Selection of Materials and Processes

Teaching Scheme:
Lectures : 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

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

1. select appropriate materials and manufacturing processes for the given application
2. identify alternative manufacturing process for given application
3. interpret mechanical properties of materials and apply these material properties in the design of components and processes
4. explain the inter-relationship between design, function, materials and process.

Unit I: [6 **hrs**]
Interaction between Function, Material, Shape and Process, Revision of engineering materials and properties, Material properties interrelationship charts such as Youngs modulus-density, Strength-density, Youngs modulus-Strength, wear rate hardness, Youngs modulus – relative cost, strength-relative cost and others

Unit II: [6 **hrs**]
Materials selection, selection strategy: material attributes, translation of design requirements, screening attribute limits, ranking by indices, search supporting information, Local conditions, method of finding indices, Weighted-Properties Method, computer aided selection, structural index

Unit III: [6 **hrs**]
Case studies related to automotive, aerospace, ship building and telecommunication industries: flywheel, springs, elastic hinges, seals, pressure vessels, kiln wall, passive solar heating, precision devices, bearings, heat exchangers, airframes, ship structures, engines and power generation, automobile structures

Unit IV: [6 **hrs**]
Materials Substitution, Pugh Method, Cost–Benefit Analysis, Cost basis for selection, causes of failure in service, Specifications and quality control, Selection for static strength, toughness, stiffness, fatigue, creep, corrosion resistance, wear resistance, material databases

Unit V: [6 **hrs**]
Process selection, ranking processes, cost, computer based process selection, Case studies: fan, pressure vessel, optical table, cast tables, manifold jacket, spark plug insulator

Unit VI: [6 **hrs**]

Selection under multiple constraints, conflicting objectives, penalty-functions, exchange constants, Case studies: connecting rods, windings of high field magnets, casing of minidisk player, disk-brake caliper

Text Books:

- Michael F. Ashby, Materials Selection in Mechanical Design, third edition, Butterworth-Heinemann, 2005
- J. Charles, F.A.A. Crane, J. A.G. Furness, Selection and Use of Engineering Materials, third edition, Butterworth-Heinemann, 2006

Reference Books:

- ASM Metals Handbook, Materials Selection and Design, Vol. 20,2010
- Myer Kutz, Handbook of Materials Selection, John Wiley & Sons, Inc., New York , 2002ISBN 0-471-35924-6

ILOE OPERATIONS RESEARCH

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1/T2/ Assignments, Quiz -40
End-Sem Exam- 60.

Course Objectives:

1. Understand the mathematical modelling of real life optimization problems.
2. Learn how to identify, formulate and solve optimization problem.
3. Learn simulation techniques.
4. Learn project management techniques.

Unit 1 **(08)**

Introduction:

Operations Research : Development, history, definitions, objectives, characteristics, limitations, phases, and applications. Optimisation models and their classifications.

Linear Programming :

Formulation of LP problem. Basic Solution. Theorems of LP. Graphical method. Simplex method (minimisation / maximisation cases). Degeneracy in LP. Duality in LP. Sensitivity analysis.

Unit 2 **(08)**

Transportation:

Introduction. Methods for finding initial solution. Test of optimality. Maximisation Transportation problem. Tran-shipment problem. Degeneracy.

Assignment Problem :

Introduction. Solution methods. Variations of the assignment problem. Traveling Salesman Problem.

Unit 3 **(08)**

Sequencing Models: Scheduling and sequencing. Assumptions in sequencing models. Processing "n" jobs on machines. Processing of two jobs on machines with each having different processing order.

Inventory Control System (Quantitative Approach) :

Introduction. Meaning of Inventory Control. Functional classifications of Inventories. Advantages of Inventory Control. Costs associated with Inventories. Advantages of Inventory Control. Costs associated with Inventories. Deterministic Inventory Models : economic lot size with instantaneous replenishment with and without shortage costs, economic lot

size with finite replenishment with and without shortage, economic lot size models with quantity discount.

Unit 4 **(05)**

Replacement Models :

Replacement of capital equipment that deteriorates with time : value remains same during the period, and it changes with constant rate during the period, Replacement of an equipment that deteriorates with an alternate equipment, Replacement of items that fail without deteriorating.

Simulation :

Monte -Carlo Method.

Unit 5 **(08)**

Queuing Theory:

Queuing Systems : Introduction, cost associated with, characteristics, operating characteristics and probability distributions. Classification of queuing models. Kendall's notations. Models : {(M/M/1) : (α / FSFS)}. minimum cost service rate.

Theory of Games:

Introduction, two–person zero-sum game. Minimax and Maximin principle. Saddle point. Methods for solving game problems with mixed strategies. Introduction to graphical, and iterative methods for solving game problems.

Unit 6 **(08)**

Network Models: Introduction to PERT / CPM and its importance in project management. Concepts and construction of network diagrams. Critical path and project duration, floats, network crashing, optimum project duration and cost, PERT activity, time estimate, probability of completion of a project on before specified time, Resource allocation and load smoothening.

Text Books

1. Gupta P. K. and Hira D. S. : Operations Research, S Chand & Company Ltd.
2. Sharma J. K. : Mathematical Models in Operations Research, Tata McGraw – Hill Publishing Company Limited.

Reference Books

1. Taha H. A. : Operations Research : An Introduction, Prentice Hall of India Pvt. Ltd.
2. Wagner H. N. : Principles of Operations Research with applications to Managerial Decisions, Prentice Hall of India Pvt. Ltd.
3. Sharma S. D., Kedar Nath : Operations Research, Ram Nath & Co.
4. R. Panneerselvam : Operations Research, Prentice Hall of India Pvt. Ltd
5. Wiest J. D. & Levy F. K.: Managerial Guide to PERT/CPM, Prentice Hall of India Pvt. Ltd.
6. Srinath L.S "PERT & CPM principles & Applications" Affiliate East West Press (P) Ltd., New Delhi, 1975.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Develop a general understanding of the Operational Research (OR) approach to decision making.
2. Develop network planning procedures for solving logistic and scheduling problems.
3. Formulate inventory and queuing problems and generate optimal solutions.
4. Identify best techniques to solve a specific problem

OPERATIONS EFFICIENCY

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
3- Presentations -25 marks each.
End-Sem Exam- 25.

Unit 1 **(09hrs)**

What is Operations Efficiency?

Operations Efficiency is an end to end system where in-house developed processes and tools are used to enhance the productivity of the organization.

Operations Efficiency aims at reducing the operational expenses. In other words, operations efficiency assists in increasing the operational profits, the biggest benefit for any organization.

Operations Efficiency aims at standardizing and implementing processes which brings in organizational discipline and rigor. In today's highly competitive business world, it separates the "Winners" from the "Also Rans".

Unit 2 **(14hrs)**

What are the topics covered in this Course?

1. "Explore" Phase
    - Problem Identification
    - Root Cause Analysis
    - Case Study from Food & Beverage Industry
2. "Define" Phase
    - Business Process Reengineering
    - Compare and Contrast; Cost-Benefit Analysis
    - Formalize the Solution
    - Case Study from Air Transportation Industry

Unit 3 **(11hrs)**

What are the topics covered in this Course?

3. "Implement" Phase
    - Process Planning and Standardization
    - Change Management
    - Phased Roll-out
    - Case Study from Apparel Retail Industry
4. "Sustenance" Phase
    - Process Management through ERP Tools
    - Continuous Process Improvement
    - Spot Audits and MIS monitoring
    - Case Study from Telecom Industry

Unit 4 **(11hrs)**

What are the topics covered in this Course?

5. "Benefits" Phase
    - On-going process benefits; systems integration
    - On-going financial benefits
    - On-going competitive benefits

Case Studies from various Industries
Successful Transfer of the Operations Efficiency Practices across Industries is also covered in this Course.

Text Books

There is no official reference book for this Course since it is primarily centered around professional situations.
The Instructor's professional experiences and analytical cases at industry leading organizations like UPS, Gap Inc., Starbucks Coffee Company, Madura Garments and !dea Cellular Limited will form the core material of the Course.

Reference Books

For additional information on this topic, students can check the below mentioned reference materials.

Good to Great	Jim Collins	Harper Collins Publishers, 2002
Built to Last	Jim Collins	Harper Collins Publishers, 2005
The McKinsey Way	Ethan M. Rasiel	Tata McGraw Hill, 2003
How Dell Does It	Steven Holzner	Tata McGraw Hill, 2006
The Wal-Mart Effect	Charles Fishman	Penguin Books, 2007
Harvard Business Review, Various Authors		Monthly Editions, 2009

College of Engineering, Pune
Shivajinagar, Pune

B.Tech. ILOE
Syllabus of 'Polymer Technology ILE)'
(ILOE offered by Applied Science dept)

Test 1: 20 marks, 1 hr duration
Test 2: 20 marks, (presentation)
ESE: 60 Marks, (3 hrs duration)

Course Outcomes

a. Able to classify between various polymer mechanisms , polymerization techniques
b. Identify relation between structure property and application of polymers in different fields of Engineering.
c. Students will be familiar with composites, specialty polymers, photo luminescent polymers, high strength high thermal stability polymers
d. Appreciating impact of development in polymers in different engineering applications.

Unit – I: Introduction **(3Hrs)**
Polymer & macro molecule, monomer, functionality, copolymer, polymer blend, plastic and resin, natural polymers. Classification of polymers: based on source, structure, applications, thermal behavior, mode of polymerization..

Unit-II: Properties of polymers **(6 Hrs)**
Crystalline and amorphous status, melting and glass transition temperatures and their determination, effect of polymer structure on mechanical, physical, chemical, and thermal properties. Thermodynamics of polymer dissolution.

Unit –III: : Commercially important polymersrs **(7 Hrs)**
Synthesis, properties and application of some important polymers; i) Polyethylene (HDPE&LDPE), ii) Teflon iii) Photo luminescent polymers viii) Silicones ix) conducting x)Kevlar (aramid) x) thermocole xi) Inorganic polymers xii) polymer composites

Unit-IV: Mechanisms of Polymerization and polymerisation techniques **(9 Hrs)**
Condensation, and Addition polymerization; a) free radical addition polymerization,
Mass or Bulk polymerization process, solution, suspension polymerization process and emulsion polymerization method comparison of merits and demerits of these methods. brief description of : i) Compression and transfer moulding ii) Injection moulding iii) Extrusion iv) Blow moulding v) Calendaring vi) Laminating and pultrusion

Unit-V: Polymer additives **(7 Hrs)**
Role of the following additives in the polymers: i) Fillers and reinforcing fillers ii) Plasticizers iii) Lubricants iv) Antioxidants and UV stabilizers v) Blowing agents vi)Coupling agents vii)Flame retardents viii) Inhibitors Compounding of polymer resins,

Unit VI :
Polymer Degradation techniques, Bio compatibility, Polymer Waste Management **(4 Hrs)**

Textbook & Reference:
Text book of polymer science by Billmeyer, F.W. Jr., Wiely&sons
Polymer Science by Gowarikar