



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTAPUR – 515 002 (A.P) INDIA

B.TECH. - MECHANICAL ENGINEERING
Proposed Course Structure (R20) – III & IV Year

Semester–V						
S.No.	Course Code	Course Name	L	T	P	Credits
1.	20A03501	CAD/CAM	3	0	0	3
2.	20A03502	Design of Machine Members	3	0	0	3
3.	20A03503T	Metrology and Measurements	3	0	0	3
4.	20A03504a 20A03504b 20A03504c	Professional Elective - I a. Automation & Robotics b. Tool Design c. Power Plant Engineering	3	0	0	3
5.		Open Elective – I	3	0	0	3
6.	20A03503P	Metrology and Measurements Laboratory	0	0	3	1.5
7.	20A03506	Computer Aided Modeling Laboratory	0	0	3	1.5
8.	20A03507	Skill oriented course - III Innovation through IoT	1	0	2	2
9.	20A03508	Evaluation of Community Service Project/ Internship				1.5
Total						21.5

Open Elective Course – I

S.No	Course Code	Course Name	Offering Branch
1	20A01505	Building Technology	CE
2	20A02505	Electric Vehicles	EEE
3	20A04505	Digital Electronics	ECE
4	20A05505a	Java Programming	CSE & Allied /IT
5	20A05505b	Introduction to Machine Learning	
6	20A12502	Mobile Application Development using Android	
7	20A27505	Computer Applications in Food Processing	FT
8	20A54501	Optimization Techniques	Mathematics
9	20A56501	Materials Characterization Techniques	Physics
10	20A51501	Chemistry of Energy Materials	Chemistry
11	20A52501	Academic Writing and Public Speaking	HSMC

Note:

1. A student is permitted to register for Honours or a Minor in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to their Minor from V Semester onwards.
2. A student shall not be permitted to take courses as Open Electives/Minor/Honours with content substantially equivalent to the courses pursued in the student's primary major.
3. A student is permitted to select a Minor program only if the institution is already offering a Major degree program in that discipline



Semester–VI						
S.No	Course Code	Course Name	L	T	P	Credits
1.	20A03601	Dynamics of Machinery	3	0	0	3
2.	20A03602	Finite Element Methods (FEM)	3	0	0	3
3.	20A03603	Heat Transfer	3	0	0	3
4.	20A03604a 20A03604b 20A03604c	Professional Elective – II a. Non-Destructive Testing (NDT) b. Production and operations management c. Total Quality Management (TQM)	3	0	0	3
5.		Open Elective Course – II	3	0	0	3
6.	20A03606	Computer Aided Design Laboratory	0	0	3	1.5
7.	20A03607	Computer Aided Manufacturing Laboratory	0	0	3	1.5
8.	20A03608	Heat Transfer Laboratory	0	0	3	1.5
9.	20A03609	Skill oriented course - IV 3D Printing practice	1	0	2	2
10.	20A99601	Mandatory Non-credit Course Intellectual Property Rights & Patents	2	0	0	0
Total						21.5
Industry Internship (Mandatory) for 6 - 8 weeks duration during summer vacation						

Open Elective Course – II

S.No	Course Code	Course Name	Offering Branch
1	20A01704	Environmental Economics	CE
2	20A02605	Smart Electric Grid	EEE
3	20A04704	Signal Processing	ECE
4	20A04701b	Introduction to Internet of Things	ECE/CSE
5	20A05605a	Principles of Operating Systems	CSE & Allied /IT
6	20A05605b	Artificial Intelligence	
7	20A12603	Data Analytics Using R	
8	20A27605	Food Refrigeration and Cold Chain Management	FT
9	20A54701	Wavelet Transforms & its applications	Mathematics
10	20A56701	Physics Of Electronic Materials and Devices	Physics
11	20A51701	Chemistry of Polymers and its Applications	Chemistry
12	20A52702	English Literary Spectrum	HSMC



Semester–VII						
S.No.	Course Code	Course Name	L	T	P	Credits
1.	20A03701a 20A03701b 20A03701c	Professional Elective Course– III 1. Modern manufacturing Methods 2. Design for Manufacturing (DFM) 3. Operations Research	3	0	0	3
2.	20A03702a 20A03702b 20A03702c	Professional Elective Course– IV 1. Automobile Engineering 2. Mechanical Vibrations 3. Refrigeration & Air Conditioning	3	0	0	3
3.	20A03703a 20A03703b 20A03703c	Professional Elective Course– V 1. Mechatronics & MEMS 2. Design of Oil Hydraulics and Pneumatics 3. Geometric dimensioning and tolerances	3	0	0	3
4.	20A52701a 20A52701b 20A52701c	Humanities Elective – II 1. Entrepreneurship and Incubation 2. Management Science 3. Enterprise Resource Planning	3	0	0	3
5.		Open Elective Course – III	3	0	0	3
6.		Open Elective Course – IV	3	0	0	3
7.	20A03706	Skill oriented course - V Industrial Automation	1	0	2	2
8.	20A03707	Evaluation of Industry Internship				3
Total						23

Open Elective Course – III

S.No	Course Code	Course Name	Offering Branch
1	20A01705	Cost Effective Housing Techniques	CE
2	20A02704	IOT Applications in Electrical Engineering	EEE
3	20A04705	Electronic Sensors	ECE
4	20A05704a	Web Technologies	CSE & Allied /IT
5	20A05704b	VR & AR for Engineers	
6	20A05704c	Agile Methodologies	
7	20A27704	Human Nutrition	FT
8	20A54702	Numerical Methods for Engineers	Mathematics
9	20A56702	Sensors And Actuators for Engineering	Physics
10	20A51702	Chemistry of Nanomaterials and Applications	Chemistry
11	20A52703	Indian Constitution	HSMC

Open Elective Course – IV



S.No	Course Code	Course Name	Offering Branch
1	20A01706	Health, Safety & Environmental	CE
2	20A02705	Renewable Energy Systems	EEE
3	20A04706	Microcontrollers and Applications	ECE
4	20A05705a	Cyber Security	CSE & Allied /IT
5	20A05705b	Full Stack Development	
6	20A12705	Industrial IoT	
7	20A27705	Waste and Effluent Management	FT
8	20A54703	Number theory & its Applications	Mathematics
9	20A56703	Smart Materials and Devices	Physics
10	20A51703	Green Chemistry and Catalysis for	Chemistry
11	20A52704	Gender Studies	HSMC

Semester-VIII							
S.No.	Course Code	Course Name	Category	L	T	P	Credits
1.	20A03801	Full Internship & Project work	PR	-	-	-	12
Total							12

COURSES OFFERED FOR HONOURS DEGREE IN MECHANICAL ENGINEERING

S.No.	Course Code	Course Title	Contact Hours per week		Credits
			L	T	
1	20A03H01	Mechanics and manufacturing of Composite materials	3	1	4
2	20A03H02	Application of Computational Fluid Dynamics	3	1	4
3	20A03H03	Advanced Automotive Electronics	3	1	4
4	20A03H04	Applications of Optimization Techniques	3	1	4
5	20A03H05	MOOC Course			2
6	20A03H06	MOOC Course			2

LIST OF MINORS OFFERED TO MECHANICAL ENGINEERING

S.No.	Minor Title	Department offering the Minor
1.	Construction Technology	Civil Engineering
2.	Environmental Geotechnology	Civil Engineering
3.	Energy Systems	EEE
4.	Internet of Things	ECE
5.	Food Science	Food Technology
6.	Artificial Intelligence & Data Science	CSE & Allied/IT
7.	Virtual & Augmented Reality	
8.	Blockchain	



B.Tech (ME)– III-I Sem

L	T	P	C
3	0	0	3

(20A03501) CAD/CAM

Course Objectives:

- Understand the basics of CAD/CAM, geometric representation, transformations.
- Explain geometric modeling methods in CAD.
- Familiarize numerical control (NC), computer numerical control (CNC) and direct numerical control (DNC) machines.
- Impart knowledge on manual part programming and computer aided part programming.
- Explain the principles robotics, CIM, AR,VR and AI in CIM

Course Outcomes:

- Apply the basics of geometric representation and transformations in CAD/CAM. L3
- Choose geometric modelling methods for building CAD models. L1
- Compare NC, CNC and DNC. L2
- Develop manual and computer aided part programming for turning and milling operations. L3
- Summarize the principles of robotics AR, VR and AI in CIM.

UNIT I Introduction to CAD/CAM

CAD/CAM: Introduction, hardware and software, I/O devices, benefits. Graphics standards-Neutral file formats – IGES, STEP.

2D and 3D geometric transformations: Translation, scaling, rotation, mirroring, homogenous transformations, concatenation of transformations, viewing transformations.

UNIT II Geometric Modelling

Parametric representation: Representation of curves, Hermite curves, Spline, Bezier and B-spline curves in two dimensions; Geometric modelling of surfaces: Surface patch, Coons and bicubic patches, Bezier and B-spline surfaces, sweep surfaces, surface of revolution, blending of surfaces;

Geometric Modelling of Solids: Wireframe, surface modelling, solid entities, Boolean operations, CSG approach and B-rep of solid modelling, geometric modelling of surfaces.

UNIT III Computer Aided Manufacturing (CAM):

Computer Aided Manufacturing (CAM): Structure of numerical control (NC) machine tools, designation of axes, drives and actuation systems, feedback devices, computer numerical control (CNC) and direct numerical control (DNC), adaptive control system, CNC tooling, automatic tool changers and work holding devices, functions of CNC and DNC systems.

UNIT IV Part Programming and APT Programming

Part Programming: Part programming instruction formats, information codes, preparatory functions, miscellaneous functions (G-codes, M-codes). Tool codes and tool length offset, interpolations canned cycles.

APT Programming: APT language structure, APT geometry, Definition of point, line, circle, plane.

APT Motion Commands: set-up commands, point to point motion commands; continuous path motion commands part programming preparation for typical examples (milling and turning operation)

UNIT V Automation

Automation: Anatomy and configuration of robot, characteristics of robots, grippers, application of robots in manufacturing, robot programming languages, Group Technology, MRP –I & MRP – II, Introduction to computer integrated manufacturing, Introduction to Virtual Reality (VR), Augmented Reality (AR) and Artificial Intelligence (AI).

Textbooks:

1. P. N. Rao, CAD/CAM: Principles and applications, 3/e, Tata McGraw-Hill, Delhi, 2017.
2. Ibrahim Zeid, R.Siva Subramanian, CAD/CAM: Theory and Practice, 2/e, Tata McGraw-Hill, Delhi, 2009.

Reference Books:



1. Mikell P. Groover, Emory W. Zimmers , CAD/CAM, 5/e, Pearson Prentice Hall of India, Delhi, 2008.
2. P. Radhakrishnan, S. Subramanyan & V. Raju, CAD/CAM/CIM, 3/e, New Age International Publishers, 2008.
3. Computer Aided Manufacturing, 3/e, Tien Chien Chang, Pearson, 2008.

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc20_me44/preview
- <https://www.youtube.com/watch?v=EgKc9L7cbKc>
- <https://www.youtube.com/watch?v=KXFpTb9cBpY>
- https://web.iitd.ac.in/~hegde/cad/lecture/L01_Introduction.pdf
- https://www.vssut.ac.in/lecture_notes/lecture1530947994.pdf
- https://www.iare.ac.in/sites/default/files/lecture_notes/CAD_CAM_LECTURE_NOTES.pdf



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– III-I Sem
(20A03502) DESIGN OF MACHINE MEMBERS

L T P C
3 0 0 3

Course Objectives:

- Provide an introduction to design of machine elements.
- Familiarize with fundamental approaches to failure prevention for static and dynamic loading.
- Explain design procedures to different types of joints.
- Teach principles of clutches and brakes and design procedures.
- Instruct different types of bearings and design procedures.

Course Outcomes:

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

- Estimate safety factors of machine members subjected to static and dynamic loads. (L5)
- Design fasteners subjected to variety of loads. (L6)
- Select of standard machine elements such as keys, shafts, couplings, springs and bearings. (L1)
- Design clutches brakes and spur gears. (L6)

UNIT I Introduction, Design for Static and Dynamic loads

Mechanical Engineering Design: Design process, design considerations, codes and standards of designation of materials, selection of materials.

Design for Static Loads: Modes of failure, design of components subjected to axial, bending, torsional and impact loads. Theories of failure for static loads.

Design for Dynamic Loads: Endurance limit, fatigue strength under axial, bending and torsion, stress concentration, notch sensitivity. Types of fluctuating loads, fatigue design for infinite life. Soderberg, Goodman and modified Goodman criterion for fatigue failure. Fatigue design under combined stresses.

UNIT II Design of Bolted and Welded Joints

Design of Bolted Joints: Threaded fasteners, preload of bolts, various stresses induced in the bolts. Torque requirement for bolt tightening, gasketed joints and eccentrically loaded bolted joints.

Welded Joints: Strength of lap and butt welds, Joints subjected to bending and torsion. Eccentrically loaded welded joints.

UNIT III Power transmission shafts and Couplings

Power Transmission Shafts: Design of shafts subjected to bending, torsion and axial loading. Shafts subjected to fluctuating loads using shock factors.

Couplings: Design of flange and bushed pin couplings, universal coupling.

UNIT IV Design of Clutches, Brakes and Springs

Friction Clutches: Torque transmitting capacity of disc and centrifugal clutches. Uniform wear theory and uniform pressure theory.

Brakes: Different types of brakes. Concept of self-energizing and self-locking of brake. Band and block brakes, disc brakes.

Springs: Design of helical compression, tension, torsion and leaf springs.

UNIT V Design of Bearings and Gears

Design of Sliding Contact Bearings: Lubrication modes, bearing modulus, McKee's equations, design of journal bearing. Bearing Failures.

Design of Rolling Contact Bearings: Static and dynamic load capacity, Stribeck's Equation, equivalent bearing load, load-life relationships, load factor, selection of bearings from manufacturer's catalogue.

Design of Gears: Spur gears, beam strength, Lewis equation, design for dynamic and wear loads.

Textbooks:

1. R.L. Norton, Machine Design an Integrated approach, 2/e, Pearson Education, 2004.
2. V.B.Bhandari, Design of Machine Elements, 3/e, Tata McGraw Hill, 2010.



3. Dr. N. C. Pandya & Dr. C. S. Shah, Machine design, 17/e, Charotar Publishing House Pvt. Ltd, 2009.

Reference Books:

1. R.K. Jain, Machine Design, Khanna Publications, 1978.
2. J.E. Shigley, Mechanical Engineering Design, 2/e, Tata McGraw Hill, 1986.
3. M.F.Spotts and T.E.Shoup, Design of Machine Elements, 3/e, Prentice Hall (Pearson Education), 2013.
4. K. Mahadevan & K.Balaveera Reddy, Design data handbook, CBS Publications, 4/e, 2018.

Online Learning Resources:

- <https://www.yumpu.com/en/document/view/18818306/lesson-3-course-name-design-of-machine-elements-1-nptel>
- <https://www.digimat.in/nptel/courses/video/112105124/L01.html>
- <https://dokumen.tips/documents/nptel-design-of-machine-elements-1.html>
- <http://www.nitttrc.edu.in/nptel/courses/video/112105124/L25.html>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– III-I Sem **L T P C**
3 0 0 3

(20A03503T) METROLOGY AND MEASUREMENTS

Course Objectives:

- Introduce the basic concepts of metrology and measurement methods.
- Demonstrate the importance of metrology in manufacturing
- Explain the concepts of transducers and its practical applications.
- Expose with various measuring instruments
- Familiarize calibration methods of various measuring instruments.

Course Outcomes:

- List various measuring instruments used in metrology.
- Examine geometry of screw threads and gear profiles.
- Measure force, torque and pressure.
- Calibrate various measuring instruments.

UNIT I**Concept of measurement**

Concept of Measurement: General concept-generalized measurement system, units and standards, measuring instruments, sensitivity, readability, range of accuracy, precision, static and dynamic response, repeatability, systematic and random errors, correction, calibration, terminology and limits fits and tolerances, hole basis and shaft basis system, interchangeability.

Limit Gauges And Gauge Design: Plug, Ring, Snap, Gap, Taper gauges. Taylor's principle. Design of Go and No Go gauges.

Linear and Angular Measurement: Linear measuring instruments: Vernier instruments, micrometers, slip gauges, tool makers microscope. Comparators: Mechanical, pneumatic and electrical. **Angular measurements:** Sine bar, bevel protractor and angle dekkor, rollers and spheres used to determine the tapers.

UNIT – II**Flatness and Surface Roughness measurement**

Flatness Measurement: Measurement of flatness – straight edges – surface plates, optical flat and autocollimators, interferometers and their applications.

Surface Roughness Measurement: Terminology systems, differences between surface roughness and surface waviness- Numerical assessment of surface finish - CLA, R.M.S Value- R_a , R_z values, Methods of measurement of surface finish-profilograph, talysurf, BIS symbols for indication of surface roughness.

UNIT – III**Screw Thread and Gear Measurement**

Screw thread measurements: Elements of threads, errors in screw threads, various methods for measuring external and internal screw threads, screw thread gauges.

Gear Measurement: Gear tooth terminology, measurement of gear elements-run out, lead, pitch backlash, profile, pressure angle, tooth thickness, diameter of gear, constant chord and base tangent method.

Coordinate Measuring Machine (CMM)- Construction and features.

UNIT – IV**Measurement of Displacement and Strain**

Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezo-electric, inductive, capacitance, resistance, ionization and photoelectric transducers, calibration procedures.

Measurements of Strain: Various types of electrical strain gauges, gauge factor, method of usage of resistance strain gauge for bending, compressive and tensile strains, usage for measuring torque, strain gauge rosettes.



UNIT – V

Measurement of Force, Torque and Pressure

Measurement of Force: Direct method - analytical balance, platform balance; elastic members – load cells, cantilever beams and proving rings.

Measurement of Torque: Torsion bar dynamometer, servo controlled dynamometer and absorption dynamometer.

Measurement of Pressure: Standards and calibration, basic methods of pressure measurement, dead weight gauges and manometers, High and low pressure measurement, Elastic transducers.

Textbooks:

1. Beckwith, Marangoni, Linehard, Mechanical Measurements, 6/e, PHI, 2013.
2. R.K. Jain, Engineering Metrology, 20/e, Khanna Publishers, 2013.

Reference Books:

1. Mahajan, Engineering Metrology, 2/e, Dhanpat Rai, 2013.
2. S.Bhaskar, Basic Principles - Measurements and Control Systems, Anuradha Publications, 2014.
3. Anand K Bewoor & Vinay A Kulkarni, Metrology & Measurement, 15/e, McGrawHill, 2015.
4. D.S. Kumar, Mechanical Measurements & Control, Metropolitan Publishers, 5/e, 2015.

Online Learning Resources:

- https://nitsri.ac.in/Department/Mechanical%20Engineering/MEC_405_Book_2,_for_Unit_2B.pdf
- <https://www.digimat.in/nptel/courses/video/112104250/L47.html>
- <https://www.digimat.in/nptel/courses/video/112106138/L01.html>
<https://www.digimat.in/nptel/courses/video/112106179/L01.html>
<https://www.youtube.com/watch?v=tczyyM4Dykc>
- https://www.youtube.com/watch?v=_UsAiZmRC1M
<https://www.youtube.com/watch?v=oCkaxMI19X8>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– III-I Sem **L T P C**
3 0 0 3

(20A03504a) AUTOMATION AND ROBOTICS
(PROFESSIONAL ELECTIVE-I)

Course Objectives:

The objectives of this course are to

- Describe the basic concepts of automation in manufacturing systems.
- Acquire the fundamental concepts of automated flow lines and their analysis.
- Classify automated material handling, automated storage and retrieval systems.
- Illustrate adaptive control systems and automated inspection methods.
- Define the fundamental concepts of industrial robotics.
- Apply basic mathematics to calculate the robot kinematic and dynamic mechanics
- Understand the robot programming methods and software packages.

Course Outcomes:

At the end of the course student will be able to

- Classify the types of hardware components of automation and control system.
- Design a simple material handling system for low-cost manufacturing
- Design a simple gripper for robot
- Compare the types of actuators used in robot manipulator
- Understand the requirements and features of robot programming
- Demonstrate the various applications of robots in manufacturing

UNIT I Introduction

Introduction: Automation in production system, need, types, Principles and Strategies of automation, levels of automation, basic elements of an automated system, hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

Automated flow lines & transfer mechanisms, fundamentals of transfer Lines, flow lines with or without buffer storage.

UNIT II Assembly Line Balancing and Automated Manufacturing System

Assembly Line Balancing: Assembly process and systems assembly line, line balancing algorithms, ways of improving line balance, flexible assembly lines.

Material handling and Identification Technologies: Overview of automatic material handling systems, principles and design consideration, material transport systems, storage systems, overview of automatic identification methods.

Automated Manufacturing Systems: Components, classification and overview of manufacturing systems, manufacturing cells, GT and cellular manufacturing, FMS and its planning and implementation.

UNIT III Introduction to Robotics

Introduction: Brief history of robots, classification of robot, functional line diagram, degrees of freedom. Elements of robot - types and its functions, factors to be considered in the design of grippers.

Robot Actuators And Feedback Components: Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.

UNIT IV Kinematics and Dynamics of a Manipulator

Manipulator Kinematics: Homogenous transformations as applicable to translation, rotations- D-H notation, Forward and inverse kinematics.

Manipulator Dynamics: Differential transformations, Jacobians, Lagrange - Euler and Newton - Euler formations.

UNIT V Robot Programming and Applications+

Robot Programming: Methods of programming - requirements and features of programming languages, software packages, problems with programming languages. Motion path control- slew motion, joint integrated motion, straight line motion; avoidance of obstacles.



Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading; Process - spot and continuous arc welding & spray painting; Assembly and Inspection.

Textbooks:

1. Mikell P. Groover, Automation, Production Systems and Computer Integrated Manufacturing- Pearson Education. 5/e, 2009.
2. Mikell P. Groover and Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, Industrial Robotics — McGraw Hill, 1986.

Reference Books:

1. S. R. Deb & Sankha Deb, Robotics Technology and Flexible Automation, Tata McGraw-Hill Education, 2009.
2. R K Mittal and I J Nagrath, Robotics and control, Illustrated Edition, Tata McGraw Hill India 2003.
3. Saeed B. Niku, Introduction to Robotics – Analysis, System, Applications, 2/e, John Wiley & Sons, 2010.
4. Richard D. Klafter, Thomas Robotic Engineering an integrated approach, PHI publications 1988.

Online Learning Resources:

- <https://www.digimat.in/nptel/courses/video/112104288/L01.html>
- <https://www.edx.org/learn/robotics>
- <https://www.youtube.com/watch?v=xrwz9IxpMJg>
- <https://nptel.ac.in/courses/112101098>
- https://onlinecourses.nptel.ac.in/noc20_de11/preview



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– III-I Sem

L	T	P	C
3	0	0	3

(20A03504b) TOOL DESIGN
(PROFESSIONAL ELECTIVE-I)

Course Objectives:

The objectives of this course are to

- Describe the basic concepts of Tool Design.
- Classify Fits and Tolerances used in Tool Design.
- Define the fundamental concepts of Designing of Jigs and Fixtures.
- Apply basic mathematics to design the press tool dies.
- Understand the nomenclature of the milling cutters.
- Explain the conceptual design of CNC machine tools.

Course Outcomes:

At the end of the course student will be able to

- Compare the Ferrous and non ferrous tool materials
- Classify the types of chip formation during orthogonal cutting
- Design Drill Jigs and Fixtures
- Design a simple gripper for robot
- Understand the concept of design of die and piercing operations
- Understand about the tool holding methods, Automatic tool changers and tool positions in CNC Machine

UNIT I INTRODUCTION TO TOOL DESIGN

Introduction –Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing- Challenges and requirements- Standards in tool design-Tool drawings -Surface finish – Fits and Tolerances - Tooling Materials- Ferrous and Non ferrous Tooling Materials- Carbides, Ceramics and Diamond -Non metallic tool materials-Designing with relation to heat treatment.

UNIT II DESIGN OF CUTTING TOOLS

Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters.

UNIT III DESIGN OF JIGS AND FIXTURES

Introduction – Fixed Gages – Gage Tolerances –selection of material for Gauges – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – General considerations in the design of drill jigs – Drill bushings – Methods of construction –Types of Fixtures – Vice Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures.

UNIT IV DESIGN OF PRESS TOOL DIES

Types of Dies –Method of Die operation–Clearance and cutting force calculations- Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Centre of pressure - Strip layout – Short-run tooling for Piercing – Bending dies – Drawing dies-Design and drafting.

UNIT V TOOL DESIGN FOR CNC MACHINE TOOLS

Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools- Sub plate and tombstone fixtures-Universal fixtures– Cutting tools– Tool holding methods– Automatic tool changers and tool positioners – Tool presetting– General explanation of the Brown and Sharp machine.

Textbooks:

1. Cyril Donaldson, George H.LeCain, V.C. Goold, “Tool Design”, Tata McGraw Hill Publishing Company Ltd., 2000.
2. E.G.Hoffman,” Jig and Fixture Design”, Thomson Asia Pvt Ltd, Singapore, 2004.



Reference Books:

1. P.C.Sharma, A Text book of Production Engineering, S.Chand Publications, 1999.
2. Prakash Hiralal Joshi, "Tooling data", Wheeler Publishing, 2000
3. Venkataraman K., "Design of Jigs, Fixtures and Presstools", TMH, 2005.
4. Haslehurst M., "Manufacturing Technology", The ELBS, 1978.

Online Learning Resources:

- https://www.iare.ac.in/sites/default/files/lecture_notes/TOOL%20DESIGN_Lecture_Notes.pdf
- https://www.cet.edu.in/noticefiles/261_MMP%20Lecture%20Notes-ilovepdf-compressed.pdf
- <https://www.vssut.ac.in/lecture-notes.php?url=production-engineering>
- <https://nptel.ac.in/courses/112/105/112105233/>
- <https://www.youtube.com/watch?v=7MkX-sW97rI>
- <https://nptel.ac.in/courses/112/105/112105126/#>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– III-I Sem
L T P C
3 0 0 3

(20A03504c) POWER PLANT ENGINEERING
(PROFESSIONAL ELECTIVE-I)

Course Objectives:

- Familiarize the sources of energy, power plant economics and environmental aspects.
- Outline the working components of different power plant.
- Explain renewable energy sources; characteristics, working principle, classify types, layouts, and plant operations.
- Impart types of nuclear power plants, and outline working principle and advantages and hazards.

Course Outcomes:

- Outline sources of energy, power plant economics, and environmental aspects
- Explain power plant economics and environmental considerations
- Describe working components of a steam power plant
- Illustrate the working mechanism of Diesel and Gas turbine power plants
- summarize types of renewable energy sources and their working principle
- Demonstrate the working principle of nuclear power plants

UNIT I Introduction to the Sources of Energy

Introduction to the Sources of Energy - Resources and Development of Power in India. Layouts of Steam, Hydel, Diesel, MHD, Nuclear and Gas Turbine Power Plants - Combined Power Cycles - Comparison and Selection.

Power Plant Economics and Environmental Considerations: Capital Cost, Investment of Fixed Charges, Operating Costs, General Arrangement of Power Distribution, Load Curves, Load Duration Curve. Definitions of Connected Load, Maximum Demand, Demand Factor, Average Load, Load Factor, Diversity Factor - Tariff - Related Exercises. Effluents from Power Plants and Impact on Environment - Pollutants and Pollution Standards - Methods of Pollution Control. Inspection And Safety Regulations.

UNIT II Steam Power Plant

Steam Power Plant: Modern High Pressure and Supercritical Boilers - Analysis of Power Plant Cycles - Modern Trends in Cycle Improvement - Waste Heat Recovery, Fluidized Bed Boilers., Fuel and Handling Equipments, Types of Coals, Coal Handling, Choice of Handling Equipment, Coal Storage, Ash Handling Systems.

Steam Power Plant: Combustion Process- Properties of Coal - Overfeed and Under Feed Fuel Beds, Travelling 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. Analysis of Pollution from Thermal Power Plants - Pollution Controls.CO₂ Recorders

UNIT III Diesel and Gas Turbine Power Plants

Diesel Power Plant: Diesel Power Plant: Introduction - IC Engines, Types, Construction- Plant Layout with Auxiliaries - Fuel Storage

GAS TURBINE PLANT: Introduction - Classification - Construction - Layout with Auxiliaries - Principles of Working Closed and Open Cycle Gas Turbines. Advantages And Disadvantages Combined Cycle Power Plants.

UNIT IV Hydro Electric Power Plants

Hydro Electric Power Plant: Water Power - Hydrological Cycle / Flow Measurement - Drainage Area Characteristics - Hydrographs - Storage and Pondage - Classification of Dams and Spill Ways.

Hydro Projects & Plant: Classification - Typical Layouts - Plant Auxiliaries - Plant Operation Pumped Storage Plants.

UNIT V Non-Conventional Source of Energy

Power From Non-Conventional Sources: Utilization of Solar Collectors- Principle of its Working, Wind Energy - Types of Turbines - HAWT & VAWT-Tidal Energy. MHD power Generation.



Nuclear Power Station: Nuclear Fuel - Nuclear Fission, Chain Reaction, Breeding and Fertile Materials - Nuclear Reactor -Reactor Operation.

Types Of Reactors: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast breeder Reactor, Homogeneous Reactor, Gas Cooled Reactor, Radiation Hazards and Shielding - Radioactive Waste Disposal.

Textbooks:

1. P.K. Nag, Power Plant Engineering, 3/e, TMH, 2013.
2. Arora and S. Domkundwar, A course in Power Plant Engineering, Dhanpat Rai & Co (P) Ltd, 2014.

Reference Books:

1. Rajput, A Text Book of Power Plant Engineering, 4/e, Laxmi Publications, 2012.
2. Ramalingam, Power plant Engineering, SciTech Publishers, 2013.
3. P.C. Sharma, Power Plant Engineering, S.K. Kataria Publications, 2012.

Online Learning Resources:

- https://www.iare.ac.in/sites/default/files/lecture_notes/PPE_LECTURE_NOTES.pdf
- <http://www.digimat.in/nptel/courses/video/112107291/L21.html>
- https://onlinecourses.nptel.ac.in/noc19_me63/preview
- <https://www.youtube.com/watch?v=iWWyI8CZhUw>
- https://www.youtube.com/watch?v=D0i1E_I_E_TE



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– III-I Sem

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(20A03503P) METROLOGY AND MEASUREMENTS LAB

Course Objectives:

- To experiment with measuring equipments used for linear and angular measurements.
- To find common types of errors in measurement equipment.
- To experiment with different types of sensors, transducers and strain gauges equipment.
- To make use of thermocouples for measurement of temperature.

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

- Apply different instruments to measure length, width, depth, bore diameters, internal and external tapers, tool angles, and surface roughness.
- Measure effective diameter of thread profile.
- Conduct different machine alignment tests.
- Measure temperature, displacement, and pressure.

List of Experiments:

Section A:

1. Measurement of bores by internal micrometers and dial bore indicators.
2. Use of gear teeth Vernier callipers and checking the chordal addendum and chordal height of spur gear.
3. Alignment test on the lathe and milling machine using dial indicators
4. Study of Tool makers microscope and its application
5. Angle and taper measurements by Bevel protractor, Sine bar spirit level etc.
6. Thread measurement by Two wire/Three wire method.
7. Surface roughness measurement by Talysurf instrument.
8. Use of straight edge and spirit level in finding the flatness of surface plate.

Section B:

1. Calibration of Pressure Gauges
2. Study and calibration of McLeod gauge for low pressure.
3. Calibration of transducer or thermocouple for temperature measurement.
4. Calibration of LVDT transducer for displacement measurement.
5. Calibration of capacitive transducer for angular measurement.
6. Calibration of photo and magnetic speed pickups for the measurement of speed.
7. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.

Virtual Lab:

1. To use Vernier Callipers for the measurement of dimensions of given object.
<https://amrita.olabs.edu.in/?sub=1&brch=5&sim=16&cnt=4>
2. To use Micrometer Screw Gauge for the measurement of dimensions (Length, Thickness, Diameter) of given object.
<https://amrita.olabs.edu.in/?sub=1&brch=5&sim=156&cnt=4>
3. To calculate Young's modulus of elasticity of steel wire by Vernier method
4. <https://amrita.olabs.edu.in/?sub=1&brch=5&sim=155&cnt=4>

References:

1. Dr. R. Manikandan, Metrology and Measurements laboratory manual, Notion Press; 1/e, 2020.
2. Arul R, Metrology and Measurements Lab Manual, Notion Press; 1/e, 2020.

Online Learning Resources/Virtual Labs:

- <https://amrita.olabs.edu.in/?sub=1&brch=5&sim=16&cnt=4>
- <https://amrita.olabs.edu.in/?sub=1&brch=5&sim=156&cnt=4>
- <https://amrita.olabs.edu.in/?sub=1&brch=5&sim=36&cnt=4>
- <https://www.sciencedirect.com/science/article/pii/S2212827116003929>
- <https://sjce.ac.in/wp-content/uploads/2018/04/Metrology-and-Measurement-Laboratory-Manual.pdf>



- https://www.youtube.com/watch?v=jfUNqg8iWmg&list=PL9Q_yrlFD9Opks9GDke48rETYcnBFBumj&index=5
- https://www.youtube.com/watch?v=X7PjoNEvIMs&list=PL9Q_yrlFD9Opks9GDke48rETYcnBFBumj&index=6



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– III-I Sem

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(20A03506) COMPUTER AIDED MODELING LABORATORY

Course Objectives:

- To train the students with CAD packages.
- To impart the 2D and 3D modeling skills to the students.
- To import and export different IGES files from one software to another

Course Outcomes:

- Students will be able to design different parts of mechanical equipment's
- Students will be able to apply their skills in various designing and Manufacturing Industries.

List of Experiments:

1. Generation of the following curves using “C”/ Python language
 - a) Cubic Splines
 - b) Bezier curves
 - c) B-Splines.
2. Generation of the following surfaces using “C”/Python language
 - a) Bezier surfaces
 - a) B-Spline surfaces
3. Typical tasks of Modeling using any solid modeling packages such as PRO/E, IDEAS, CATIA, etc.,
 - a) Solid Boolean algebra - 1 Exercise
 - b) Wireframe & Surface Modelling – 3 Exercises
 - c) 3D – Drafting in detail – 1 Exercise
 - d) Production Drawing with Geometric Dimensioning and Tolerances– 3 Exercises(Preferably for the assembly drawings drawn in Computer Aided Machine Drawing in previous semester)

References:

1. James D Meadows "Geometric Dimensioning and Tolerancing-Applications, Analysis & Measurement ASME Y14.5-2018.
2. KL Narayana, P Kannaiah and K.Venkat Reddy, Production Drawing, New Age publishers, 2014.
3. Ibrahim Zeid, Tata Mc Graw hill, CAD/CAM Theory and Practice, 2012.

Online Learning Resources/Virtual Labs:

- https://www.youtube.com/watch?v=er7xJFKv5k&list=PL5w7L_xR0pu2wLbJtOuK49WxJJVjyKks&index=2
- https://www.youtube.com/watch?v=Gy0MKabzDa8&list=PLrOFa8sDv6jccqLnN7UDa1YW4s_hR6YX0
- https://www.youtube.com/watch?v=k3kFC9uTdUk&list=PLM5xm8DJKViImdv5ZXxQ2NyIdSlid_jCB



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– III-I Sem
(20A03507) INNOVATION THROUGH IoT
(Skill Oriented course III)

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1	0	2	2

Course Objectives:

- To get practical knowledge on Raspberry Pi and Arduino.
- Develop the building blocks of design thinking such as empathize, ideate, prototyping, testing and validation for real-time applications.
- To apply the concepts of design thinking concepts to IoT
- To provide skills on the applications of product design.

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

- Write a program of Raspberry Pi/Arduino for IoT applications
- Understand the relationship between IoT, Cloud services and Software agents
- Explain the troubleshooting methods in IoT based systems
- Apply the design thinking concepts to any type of IoT based applications
- Define a problem statement by conducting the survey
- Design a creative solution for a specified problem.

Module 1

Introduction to Micro Controllers:

- Exp 1: Programming of Raspberry Pi3 / Arduino.
- Exp 2: Peripheral interfacing to the microcontroller.

Module 2

Introduction and applications of IoT , Cloud services & Software Agents:

- Exp 1: Trace the relationship between IoT, Cloud services and Software agents.
- Exp 2: Troubleshooting the microcontroller-based systems (IoT based systems or Products).

Module 3

Introduction to Design & Concepts of IoT: Using the concepts of IoT, Implement the 5 stages (Empathize, Define, Prototype, Ideate, Test) of Design thinking for the following

- Exp 1: Measurement of temperature and humidity (whether monitoring).
- Exp 2: Soil monitoring (Temperature, Humidity, Phosphorus, Zinc, Iron) / Crop Monitoring.
- Exp 3: Design of automatic car wiper for rain sensing
- Exp 4: Intelligent transportation system
- Exp 5: Vehicle monitoring system
- Exp 6: Traffic monitoring and control
- Exp 7: Design a device for Fleet and driver management.
- Exp 8: Smart lighting system
- Exp 9: Smart parking systems
- Exp 10: Development of Smart cities
- Exp 11: Measurement of water level

Module 4:

Conduct survey and identify the problem on the above experiments, either individual/group and to avail problem statement for further development.

Module 5:

With the help of problem statement in experiment 6, draw product/system after applying CREATE (Combine, Rearrange, Enhance, Adapt, Turn around, Eliminate) Tool.

Module 6:

Story boarding of design ideas to transform ,‘information about needs‘ into design concepts.

References:

1. Jeff Cicolani, Beginning Robotics with Raspberry Pi and Arduino, Apress, 2018.



2. Martin Bates, Interfacing PIC Microcontrollers, Embedded Design by Interactive Simulation, Elsevier Science, 2013.
3. Yasser Ismail, Internet of Things (IoT) for Automated and Smart Applications, IntechOpen, 2019.
4. Manish K Patel, The 8051 Microcontroller Based Embedded Systems, McGraw Hill Education (India), 2014.
5. Robin E Bentley, Handbook of Temperature Measurement: Temperature and Humidity measurement, Volume 1, Springer, 1998.
6. Charles Bell, Beginning Sensor Networks with Arduino and Raspberry Pi, Apress, 2014.
7. Julian Hapian-Smith, An Introduction to Modern Vehicle Design, Butterworth-Heinemann, 2001.
8. Susan McCahan, Phil Anderson, Mark Kortschot, Peter E. Weiss, Kimberly A. Woodhouse, Designing Engineers: An Introductory Text, Wiley, 2015.

Online Learning Resources/Virtual Labs:

1. <https://www.youtube.com/watch?v=IZKpCz6LEdg>
2. <https://www.youtube.com/watch?v=QZSY7lnp3zg>
3. https://www.youtube.com/watch?v=nh5x_H_llko
4. <https://www.youtube.com/watch?v=2rGaz1C0COU>
5. <https://www.youtube.com/watch?v=r-BtrSnzwTg>
6. <https://www.youtube.com/watch?v=OnjX0O9dPMc>
7. <https://www.youtube.com/watch?v=UeSKdGzXY18>
8. https://www.youtube.com/watch?v=EE7_26bq7Tg
9. <https://www.youtube.com/watch?v=ktJ5gRkF7og>
10. <https://www.youtube.com/watch?v=nVhL0cv5a5s>
11. <https://www.youtube.com/watch?v=9BpBbIk7ElY>
12. <https://www.youtube.com/watch?v=tKJZxsEeVzk>
13. <https://www.youtube.com/watch?v=euZkv0wJBIM>
14. <https://www.youtube.com/watch?v=qyoZTUGzdGY>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– III-II Sem

L	T	P	C
3	0	0	3

(20A03601) DYNAMICS OF MACHINERY

Course Objectives:

- Analysis of forces acting in mechanisms
- Effects of unbalance forces
- Modelling and analyzing the vibration behaviour of spring mass damper system
- The principles in mechanisms used for governing of machines

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

- Determine the forces acting on various linkages when a mechanism is subjected to external forces.
- Identify and correct the unbalances of rotating body
- Analyze the vibratory motion of SDOF systems.
- Reduce the magnitude of vibration and isolate vibration of dynamic systems
- Determine dimensions of Governors for speed control.

UNIT I Friction, Clutches, Brakes and Dynamometers

Friction: Inclined plane, friction of screws and nuts, pivot and collar, uniform pressure, uniform wear. Friction circle and friction axis, lubricated surfaces, boundary friction, film lubrication.

Clutches: Friction clutches- Single Disc or plate clutch, Multiple Disc Clutch, Cone Clutch, Centrifugal Clutch.

Brakes And Dynamometers: Simple block brakes, Band brake, internal expanding brake, braking of vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

UNIT – II Precession, Turning Moment Diagram and Fly Wheel

Precession: Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aeroplanes and ships.

Turning Moment Diagrams And Fly Wheels: Turning moment diagrams for steam engine, IC Engine and multi cylinder engine. Crank effort - coefficient of Fluctuation of energy, coefficient of Fluctuation of speed – Fly wheels and their design, Fly wheels for Punching machines.

UNIT – III Governors

Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung governors with auxiliary springs. Sensitiveness, isochronism and hunting. Effort and power of a governor.

UNIT – IV Balancing

Balancing: Balancing of rotating masses - single and multiple – single and different planes.

Balancing Of Reciprocating Masses: Primary and Secondary balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples – V-engine, multi cylinder inline and radial engines for primary and secondary balancing.

UNIT – V Vibration

Free and forced vibration of single degree of freedom system, Role of damping, whirling of shafts and critical speeds. Simple problems on free, forced and damped vibrations. Vibration Isolation & Transmissibility. Transverse vibrations of beams with concentrated and distributed loads. Dunkerly's method, Raleigh's method. Torsional vibrations - two and three rotor systems.

Textbooks:

1. S.S. Rattan, Theory of Machines, MGH Publishers, 3/e, 2013.
2. R.L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill, 2017.

Reference Books:

1. Thomas Bevan, Theory of machines, Pearson, 3/e, 2012.
2. J.E. Shigley, The theory of machines and mechanisms, McGraw hill, 2/e, 1995 .
3. R.S.Khurmi, J.K.Guptha, Theory of machines S.Chand publications, 2005.



Online Learning Resources:

- <https://nptel.ac.in/courses/112104114>
- <https://nptel.ac.in/courses/112101096>
- https://archive.org/details/NPTEL-MechEngr-Dynamics_of_Machines
- <https://www.youtube.com/watch?v=OlZXxPVpmBs>
- <https://www.digimat.in/nptel/courses/video/112104114/L01.html>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– III-II Sem

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3	0	0	3

(20A03602) FINITE ELEMENT METHODS

Course Objectives:

- Familiarize basic principles of finite element analysis procedure.
- Explain theory and characteristics of finite elements that represent engineering structures.
- Apply finite element solutions to structural, thermal, dynamic problem.
- Learn to model complex geometry problems and solution techniques.

Course Outcomes: Upon successful completion of this course you should be able to

- Understand the concepts behind variational methods and weighted residual methods in FEM.
- Identify the application and characteristics of FEA elements such as bars, beams, and isoparametric elements, and 3-D element.
- Develop element characteristic equation procedure and generation of global stiffness equation will be applied.
- Able to apply Suitable boundary conditions to a global structural equation, and reduce it to a solvable form.
- Able to identify how the finite element method expands beyond the structural domain, for problems involving dynamics, heat transfer and fluid flow.

UNIT I Introduction to finite element methods

Introduction to finite element methods for solving field problems, applications, Stress and equilibrium, Boundary conditions, Strain-Displacement relations, Stress- strain relations for 2D and 3D Elastic problems. Potential energy and equilibrium, Rayleigh-Ritz method, Formulation of Finite Element Equations.

One dimensional Problems: Finite element modelling of 1D bar elements coordinates and shape functions. Requirements for Convergence and Interpolation functions, Pascal's Triangle, Assembly of global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

UNIT II 1 D Analysis of Trusses and Beams

Analysis of trusses: Stiffness Matrix for 1D truss element, Stress Calculations and Problems with maximum of three elements.

Analysis of beams: Element Stiffness Matrix and Load vector for 1 D beam element, Hermite shape functions and simple problems.

UNIT III 2D Analysis

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of load Vector, Stresses.

Finite element modeling of Axi-symmetric solids subjected to axi-symmetric loading with triangular elements.

UNIT IV Quadrilateral Elements & Thermal Analysis

Quadrilateral Elements: Isoparametric, Sub parametric and Super parametric elements, Modelling of 4 noded and 8 noded quadrilateral elements and simple problems. Numerical Integration.

Steady state heat transfer analysis: One dimensional analysis of composite slab and fin.

UNIT V Dynamic analysis

Analysis of a 1D uniform shaft subjected to torsion – Simple problems

Dynamic analysis: Formulation of finite element model, element – mass matrices, evaluation of Eigen values and Eigen vectors for a bar and shaft.

Textbooks:

1. T. Chandraputla, Ashok Belegundu, Introduction to Finite Element in Engineering, Pearson Publications, 4/e, 2011.
2. S.S.Rao, The Finite Element Methods in Engineering, Elsevier Butterworth -Heinemann, 2/e, 2011.
3. S.Md.Jalaludeen, Finite Element Analysis in Engineering, 2/e, Anuradha Publications, 2016.



Reference Books:

1. J N Reddy, An introduction to the Finite Element Method, McGraw – Hill, New York, 1993.
2. R D Cook, D S Malkus and M E Plesha, Concepts and Applications of Finite Element Analysis, 3/e, John Wiley, New York, 1989.
3. K J Bathe, Finite Element Procedures in Engineering Analysis, Prentice-Hall, Englewood Cliffs, 1982.
4. G.Lakshmi Narasaiah, Finite Element Analysis, 1/e, B.S. Publications, 2008.
5. O C Zienkiewicz and R L Taylor, the Finite Element Method, 3/e. McGraw-Hill, 1989.

Online Learning Resources:

- <https://nptel.ac.in/courses/112/104/112104193/>
- <https://nptel.ac.in/courses/112/104/112104205/>
- <https://nptel.ac.in/courses/105/105/105105041/>
- <https://nptel.ac.in/courses/112/106/112106130/>
- <https://nptel.ac.in/courses/112/103/112103295/>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– III-II Sem
(20A03603) HEAT TRANSFER

L	T	P	C
3	0	0	3

Course Objectives:

- To impart the basic laws of conduction, convection and radiation heat transfer and their applications
- To familiarize the convective heat transfer concepts
- To explain basics of radiation heat transfer
- To make conversant with the heat transfer analysis related to thermal systems like heat exchangers, evaporator, and condenser.

Course Outcomes:

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

- Apply the concepts of different modes of heat transfer. (L3)
- Apply knowledge of conduction heat transfer in the design of insulation of furnaces and pipes. (L3)
- Analyse free and forced convection phenomena in external and internal flows. (L4)
- Design of thermal shields using the concepts of black body and non-black body radiation. (L5)
- Apply the basics of mass transfer for applications in diffusion of gases. (L3)

UNIT I

Introduction

Basic modes of heat transfer- rate equations- generalized heat conduction equation-various forms - steady state heat conduction solution for plane and composite slabs - cylinders - critical thickness of insulation- heat conduction through fins of uniform cross section- fin effectiveness and efficiency.

Unsteady State Heat Transfer Conduction- Transient heat conduction- lumped system analysis and use of Heisler charts.

UNIT II

Convection

Convection: Basic concepts of convection–heat transfer coefficients - types of convection –forced convection and free convection.

Free Convection: development of hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for convective heat transfer on plates and cylinders in horizontal and vertical orientation

Forced convection: in external flow–concepts of hydrodynamic and thermal boundary layer- use of empirical correlations for flow over plates and cylinders. Fluid friction – heat transfer analogy, approximate solution to laminar boundary layer equation for external flow. Internal flow – Use of empirical relations for convective heat transfer in horizontal pipe flow-problems.

UNIT III

Boiling and Condensation

Different regimes of boiling- nucleate, transition and film boiling – condensation – film wise and drop wise condensation-problems.

UNIT IV

Heat Exchangers

Types of heat exchangers- parallel flow- counter flow- cross flow heat exchangers- overall heat transfer coefficient- LMTD and NTU methods- fouling in heat exchangers-problems.



UNIT V

Radiation: Radiation heat transfer – thermal radiation – laws of radiation - Black and Gray bodies – shape factor-radiation exchange between surfaces - Radiation shields - Greenhouse effect- simple problems.

Mass Transfer: Conservation laws and constitutive equations - Fick's law of diffusion, isothermal equi-mass - Equimolal diffusion- - diffusion of gases and liquids- mass transfer coefficient.

Textbooks:

1. P.K. Nag, Heat Transfer, 3/e, Tata McGraw-Hill, 2011.
2. J.P.Holman, Heat Transfer, 9/e, Tata McGraw-Hill, 2008.
3. S. C. Arora & S. Domkundwar , A Course in Heat and Mass Transfer, Dhan pat Rai & CO.(P) LTD-Delhi , 2007.
4. R.C.Sachdeva, Fundamentals of Engineering Heat & Mass transfer, New Age International Publishers, 2017.

Reference Books:

1. F. P. Incropera and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, 6/e, John Wiley, 2007.
2. Cengel. A.Yunus, Heat Transfer- A Practical Approach, 4/e, Tata McGraw-Hill, 2007.
3. S.P. Sukhatme, A Text book of Heat Transfer, Universities Press, 2005
4. Lienhard and Lienhard, A Heat and Mass Transfer, Cambridge Press, 2011.
5. C.P. Kothandaraman and S. Subramanyan, Heat and Mass Transfer data book, New Age Publications, 2014.
6. Er.R.K.Rajput, A Text book of Heat & Mass Transfer, S.Chand publishers,1/e,2018.

Online Learning Resources:

- <https://ocw.mit.edu/courses/mechanical-engineering/2-051-introduction-to-heat-transfer-fall-2015/>
- <https://www.udemy.com/topic/heat-transfer/>
- <https://www.youtube.com/watch?v=TWTQx3W-2k8>
- https://onlinecourses.nptel.ac.in/noc20_ch21/preview
- <https://ekeeda.com/degree-courses/mechanical-engineering/heat-transfer>
- <https://www.coursera.org/lecture/thermodynamics-intro/02-04-heat-transfer-gyDfJ>
- <https://www.youtube.com/watch?v=cjJ2LV5lkB8>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– III-II Sem **L T P C**
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(20A03604a) NON-DESTRUCTIVE TESTING (NDT)
(Professional Elective – II)

Course Objectives:

- Introduce basic concepts of non-destructive testing.
- Familiarize with characteristics of ultrasonic test, transducers, rejection and effectiveness.
- Describe concept of liquid Penetrant, eddy current and magnetic particle tests, its applications and limitations.
- Explain the principles of infrared and thermal testing, applications and honey comb and sandwich structures case studies.

Course Outcomes:

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

- Explain various methods of non-destructive testing.
- Apply relevant non-destructive testing method different applications.
- Explain the applications of railways, nuclear and chemical industries.
- Outline the limitations and disadvantages of nde.
- Explain the applications of NDA of pressure vessels, casting and welding constructions

UNIT - I **Introduction to non-destructive testing** **8 Hrs**

Introduction to non-destructive testing: Radiographic test, Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography.

UNIT - II **Ultrasonic test** **8 Hrs**

Ultrasonic test: Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect , Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.

UNIT - III **Liquid penetrant, Eddy Current & Magnetic Particle Test** **10 Hrs**

Liquid Penetrant Test: Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness and Limitations of Liquid Penetrant Testing.

Eddy Current Test: Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current-Testing Effectiveness of Eddy Current Testing.

Magnetic Particle Test: Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test.

UNIT - IV **Infrared & Thermal Testing** **8 Hrs**

Infrared And Thermal Testing: Introduction and fundamentals to infrared and thermal testing–Heat transfer –Active and passive techniques –Lock in and pulse thermography–Contact and non contact thermal inspection methods–Heat sensitive paints –Heat sensitive papers –thermally quenched phosphors liquid crystals –techniques for applying liquid crystals –other temperature sensitive coatings –Inspection methods –Infrared radiation and infrared detectors–thermo mechanical behavior of materials–IR imaging in aerospace applications, electronic components, Honey comb and sandwich structures–Case studies.



UNIT - V

Industrial Applications of NDE:

8 Hrs

Industrial Applications of NDE: Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions.

Textbooks:

1. J Prasad, GCK Nair , Non destructive test and evaluation of Materials, Tata mcgraw-Hill Education Publishers, 2008.
2. Josef Krautkrämer, Herbert Krautkrämer, Ultrasonic testing of materials, 3/e, Springer-Verlag, 1983.
3. X. P. V. Maldague, Non destructive evaluation of materials by infrared thermography, 1/e, Springer-Verlag, 1993.

Reference Books:

1. Gary L. Workman, Patrick O. Moore, Doron Kishoni, Non-destructive, Hand Book, Ultrasonic Testing, 3/e, Amer Society for Nondestructive, 2007.
2. ASTM Standards, Vol 3.01, Metals and alloys.

Online Learning Resources:

- <http://www.twivirtualacademy.com/online-courses/ndt/>
- <https://www.classcentral.com/course/swayam-theory-and-practice-of-non-destructive-testing-9872>
- https://onlinecourses.nptel.ac.in/noc20_mm07/preview
- <https://www.youtube.com/watch?v=dyMR58TZMbo>
- <https://www.youtube.com/watch?v=Wam-Ewcn3aQ>
- https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_NDT_LECTURE_NOTES.pdf
- <https://lecturenotes.in/subject/390/non-destructive-testing>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– III-II Sem

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(20A03604b) PRODUCTION AND OPERATIONS MANAGEMENT

(Professional Elective – II)

Course Objectives:

At the end of the course, the student will be able to learn

- Introduction to the technical design and manufacturing operations and supply management to the sustainability of an enterprise.
- Need for forecasting and types of forecasting.
- Import the basic principles of project management and other business functions such as value engineering, purchasing, marketing, finance etc.
- Analyze the new demands of the globally competitive business environment that supply chain managers face today.
- Knowledge on various scheduling algorithms applicable to single machine, parallel machines, flow shop and job shop models.

Course Outcomes:

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

- Demonstrate the operations and supply management to the sustainability of an enterprise
- Identify the need for forecasting and understand different forecasting methods
- Identify various production and plant layouts
- Examine the quality control of the production
- Apply Just in Time (JIT) basic principles and applications
- Recommend the production schedule for productivity
- Design, analyze and implement single machine, parallel machine, flow shop and job shop scheduling algorithms

UNIT - I Introduction

10 Hours

Introduction: Operations Management – Definition, Objectives, Types of Production System, Difference between OM & PM, Historical Development of Operations Management, Current Issues in Operation Management, Product Design – Requirements of Good Product Design, Product Development – Approaches, Concepts in Product Development, Standardization, Simplification, Speed to Market, Introduction to Concurrent Engineering.

UNIT - II Forecasting:

8 Hours

Forecasting: Introduction, Statistical Forecasting Techniques, Moving Average, Exponential Smoothing Technique, Errors in Forecasting and Evaluation of Forecasting Techniques.

UNIT - III Value Engineering and Plant Layout:

8 Hours

Value Engineering and Plant Layout: Value Engineering – Objectives, Types of Values, Function and Cost, Product Life Cycle, Steps in Value Engineering, Methodology in Value Engineering, FAST Diagram and Matrix Method. Facility Location and Layout – Factor Considerations in Plant Location, Comparative Study of Rural and Urban Sites, Methods of Selection of Plant Layout, Objectives of Good layout, Principles, Types of Layout, Line Balancing

UNIT - IV Aggregate Planning and MRP:

8 Hours

Aggregate Planning and MRP: Aggregate Planning – Definition, Different Strategies, Various Models of Aggregate Planning- Transportation and Graphical Models, Master scheduling, Material Requirement Planning(MRP)- Terminology, Types of Demands, Inputs to MRP, Techniques of MRP, Lot Sizing Methods, Benefits and Drawbacks of MRP, Manufacturing Resources Planning (MRP II), Just in Time (JIT) Philosophy, Kanban System, Calculation of Number of Kanbans, Pull Systems vs. Push Systems, Requirements



for Implementation of JIT, JIT Production Process, Benefits of JIT.

UNIT - V Scheduling:

8 Hours

Scheduling: Policies, Types of Scheduling, Scheduling Strategies, Scheduling and Loading Guidelines, Forward and Backward Scheduling, Gantt Charts, Priority Decision Rules, Flow Shop Scheduling, Job Shop Scheduling, Line of Balance.

Textbooks:

1. Buffa E.S. and Sarin R.K., Modern Production / Operations Management, 8th Edition, Wiley India Pvt. Ltd., New Delhi, 2009.
2. Joseph G. Monks, Operations Management-Theory and Problems, 3rd Edition, McGraw Hill Education, 1987.

Reference Books:

1. James L. Riggs, Jim Rigs, Production Systems: Planning, Analysis and Control, 4th Edition, Wave Land Press, 1992.
2. Chary S.N., Production and Operations Management, 5th Edition, McGraw Hill Education, 2017.
3. Richard B.Chase, Ravi Shankar, Robert Jacobs F., Operations and Supply Chain Management, 15th Edition, McGraw Hill Education, 2018.
4. Pannerselvam R., Production and Operations Management, 3rd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.
5. Steven Nahmias, Tava Lennon Olsen, Production and Operation Analysis: Strategy – Quality – Analytics – Applications, 7th Edition, Waveland Press Inc., 2015.

Online Learning Resources:

- https://www.vssut.ac.in/lecture_notes/lecture1429900757.pdf
- <https://lecturenotes.in/subject/100/production-and-operation-management>
- <https://www.studocu.com/in/document/guru-gobind-singh-indraprastha-university/production-operations-management/full-unit-1-lecture-notes-6/3528988>
- https://mrcet.com/downloads/digital_notes/ME/III%20year/POM%20NOTES.pdf
- https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_OM_NOTES.pdf
- <https://nptel.ac.in/courses/112107238>
- <https://nptel.ac.in/courses/110107141>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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(20A03604c) TOTAL QUALITY MANAGEMENT (TQM)
(Professional Elective – II)

Course Objectives:

- Introduce the students, the basic concepts of Total Quality Management.
- Expose with various quality issues in Inspection.
- Gain Knowledge on quality control and its applications to real time.
- Know the extent of customer satisfaction by the application of various quality concepts.
- Understand the importance of Quality standards in Production.

Course Outcomes (CO):

At the end of this course, the student will be able to

- Develop an understanding on quality Management philosophies and frameworks
- Adopt TQM methodologies for continuous improvement of quality
- Measure the cost of poor quality, process effectiveness and efficiency to identify areas for improvement
- Apply benchmarking and business process reengineering to improve management processes.
- Determine the set of indications to evaluate performance excellence of an organization.

UNIT - I Introduction Lecture Hrs: 10
Introduction: Definition of Quality, Dimensions of Quality, Definition of Total quality management, Quality Planning, Quality costs – Analysis, Techniques for Quality costs, Basic concepts of Total Quality Management.

UNIT - II Historical Review: Lecture Hrs: 9
Historical Review: Quality council, Quality statements, Strategic Planning, Deming Philosophy, Barriers of TQM Implementation, Benefits of TQM, Characteristics of successful quality leader, Contributions of Gurus of TQM, Case studies.

UNIT - III TQM Principles: Lecture Hrs:8
TQM Principles: Customer Satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment teams, Continuous Process Improvement – Juran Trilogy, PDCA Cycle, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure Case studies.

UNIT - IV TQM Tools: Lecture Hrs:9
TQM Tools: Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA, The seven tools of quality, Process capability, Concept of Six Sigma, New Seven management tools, Case studies.

UNIT - V Quality Systems: Lecture Hrs:8
Quality Systems: Need for ISO 9000 and Other Quality Systems, ISO 9000: 2000 Quality



System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits, Case Studies.

Text Books:

1. Dale H Besterfield, Total Quality Management, Fourth Edition, Pearson Education, 2015.
2. Subburaj Ramaswamy, Total Quality Management, Tata Mcgraw Hill Publishing Company Ltd., 2005.
3. Joel E.Ross , Total Quality Management, Third Edition, CRC Press, 2017.

Reference Books:

1. Narayana V and Sreenivasan N.S, Quality Management – Concepts and Tasks, New Age International, 1996.
2. Robert L.Flood, Beyond TQM, First Edition, John Wiley & Sons Ltd, 1993.
3. Richard S. Leavenworth & Eugene Lodewick Grant, Statistical Quality Control, Seventh Edition, Tata Mcgraw Hill, 2015
4. Samuel Ho , TQM – An Integrated Approach, Kogan Page Ltd, USA, 1995.

Online Learning Resources:

- <https://www.youtube.com/watch?v=VD6tXadibk0>
- <https://www.investopedia.com/terms/t/total-quality-management-tqm.asp>
- <https://blog.capterra.com/what-is-total-quality-management/>
- <https://nptel.ac.in/courses/110/104/110104080/>
- https://onlinecourses.nptel.ac.in/noc21_mg03/preview
- <https://nptel.ac.in/courses/110/104/110104085/>
- <https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-mg39/>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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(20A03606) COMPUTER AIDED DESIGN LABORATORY

Course Objectives:

- To use the commercial Finite Element packages to build Finite Element models and solve a selected range of engineering problems.
- To validate a Finite Element model using a range of techniques.
- To communicate effectively in writing to report (both textually and graphically) the method used, the implementation and the numerical results obtained.
- To discuss the accuracy of the Finite Element solutions.

Course Outcomes

- Ability to solve engineering problems using the commercial software's such as ANSYS, SIMUFACT, ABAQUS, SIMULIA, Mathematical, MAT LAB, GNU Octave, Scilab, MAPLE/ COMSOL.

List of Experiments:

Finite Element Analysis using Simulation package for different structures. The discretization can be done with 1-D, 2-D & 3-D elements to perform the following analysis for post processing:

1. Static Analysis

- a. Stress analysis of 2D truss.
- b. Stress analysis of a plate with a circular hole and L-Bracket – 2D and 3D
- c. Stress analysis of beams (cantilever, simply supported & fixed ends)
- d. Stress analysis of an axi-symmetric component
- e. Torsion based Problem

2. Thermal Analysis

- a. Conductive heat transfer analysis of a 2D and 3D components
- b. Conduction and Convective heat transfer analysis of a 2D component
- c. Heat transfer rate of a composite wall
- d. Coupled field analysis of a component

3. Modal Analysis

- a. Mode frequency analysis of a 2D component
- b. Mode frequency analysis of beams (cantilever, simply supported)

Note: Students should practice the above problems with combinations of ANSYS, Octave, Scilab, MATLAB/ Mathematica, MAPLE/COMSOL etc. based on the available software's of either licensed or freeware. Staff can make use of Freeware in solving the FEA Problems with different combination of simulation packages.

References:

1. Nitin S Gokhale and Sanjay Deshpande, Practical Finite Element Analysis, Finite to Infinite Publishers, 1/e, 2008.
2. Joe Stefanelli, Finite Element Analysis in Practice-Instructor Manual, Auto-desk, 2010.
3. J.M. Ferreira, MATLAB codes for Finite Element Method", Springer Publications, 2020.
4. Heinrich, Juan C., Pepper, Darrell W, The finite element method: basic concepts and applications with MATLAB, MAPLE, and COMSOL:, CRC Press, 3/e, 2017.

Online Learning Resources/Virtual Labs:

- <https://www.youtube.com/watch?v=1gamqpyZjTg>
- <https://www.youtube.com/watch?v=4c-sPXold0w>
- <https://www.youtube.com/watch?v=XSRYRnEfPMqA>
- <https://au.mathworks.com/discovery/finite-element-analysis.html>
- https://w3.pppl.gov/m3d/reference/fsem_intro.pdf
- https://www.youtube.com/watch?v=W XKUCKy9CtA&list=PL3YYYtsmbXgdRoY27y3ZEjF5qE7YYeX_I
- <https://www.youtube.com/watch?v=n3FDQqrRJqA>



- https://www.youtube.com/watch?v=oHYVzAih_VM



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(20A03607) COMPUTER AIDED MANUFACTURING LABORATORY

Course Objectives:

- To get practical knowledge on manual part programming of CNC lathe machine by using G codes and M codes.
- To get practical knowledge on manual part programming of CNC milling and drilling machine by using G codes and M codes.
- To get the practical knowledge on APT language.
- To get practical application of Industrial Robots

Course Outcomes:

Upon successful completion students should be able to:

- Use and understanding of Preparatory and Miscellaneous (G& M) codes to generate or edit a program which will operate a CNC Lathe/ Milling and Drilling.
- Apply mathematical methods to calculate World/ Joint/ Tool coordinates in robotics.
- Apply the programming concepts of Robots for simple applications in material handling and assembly

List of Experiments:

1. Manual part programming (using G and M codes) in CNC Lathe Machine:
 - a. Part programming for linear interpolation, circular interpolation, chamfering and grooving.
 - b. Part programming by using standard Canned cycles for facing, turning, taper turning and thread cutting, Chess Bishop profile
 - c. Multiple turning operations which cover all lathe operations covering maximum G codes and M codes
2. Manual part programming (using G and M codes) in CNC Milling Machine:
 - a. Part programming for linear interpolation, circular interpolation and contour motions.
 - b. Part programming involving Canned cycles for drilling, Peck drilling and boring and pocketing & Mirroring.
 - c. Part programming for Gear cutting profile
3. APT (Automatically Programmed Tools) Language-Cutting tool path generation by using any CAM simulation package / Experiment for different machining operations.
 - a. APT Lathe Programming's – 2 Experiments
 - b. APT Milling Programming's - 2 Experiments
4. Robotics: By using 5 or 6 – Axis robot
 - a. Pick and Place with palletizing/ de-palletizing of components
 - b. Nut, Bolt and Washer Assembly with robot.

References:

1. P Radhakrishnan, Computer Numerical Control (CNC) Machines, New Central Book agency, 2013.
2. S.R.DEB, Robotics Technology and Flexible Automation, McGraw Hill Education, 2017.
3. CHAO- HWA CHANG and MICHEL. A. MELKANOFF, NC Machine Programming and software Design, Prentice Hall Publishers, 1989.

Online Learning Resources/Virtual Labs:

- <https://www.youtube.com/watch?v=NCEHRvFQqMo>
- https://www.youtube.com/watch?v=Gwy_Vh46fCM
- <https://www.youtube.com/watch?v=0sXLwytzT2Y>
- <https://www.youtube.com/watch?v=rgZT3RtfUqA>
- <https://www.youtube.com/watch?v=osqX7iQEnuI>
- <https://www.youtube.com/watch?v=-F0i1LDk2XI>
- <https://www.youtube.com/watch?v=i-PgeWbDgq4>
- <https://www.youtube.com/watch?v=sJm1Nyb-AkE>
- <https://www.youtube.com/watch?v=UxO0xqvGcM>



- <https://www.youtube.com/watch?v=Ic-iKGSc7dk>



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(20A03608) HEAT TRANSFER LAB

Course Objectives:

Students undergoing this course would

- Understand different modes of heat transfer
- Gain knowledge about natural and forced convection phenomenon
- Estimate experimental uncertainty in measurements

Course Outcomes:

Upon the successful completion of course, students will be able to

- Explain different modes of heat transfer
- Identify parameters for measurement for calculating heat transfer
- Determine effectiveness of heat exchanger
- Design new equipment related to heat transfer
- Apply principles of heat transfer in wide application in industries.

List of Experiments:

1. Determine the overall heat transfer coefficient across the width of composite wall
2. Determine the thermal conductivity of a metal rod
3. Determine the thermal conductivity of insulating powder material through concentric sphere apparatus
4. Determine the thermal conductivity of insulating material through lagged pipe apparatus
5. Determine the efficiency of a pin fin in natural and forced convection.
6. Determine the heat transfer coefficient for a vertical cylinder in natural convection
7. Determine the heat transfer coefficient in forced convection of air in a horizontal tube.
8. Determine the heat transfer coefficients on film and drop wise condensation apparatus.
9. Determine the effectiveness of a parallel and counter flow heat exchanger.
10. Study the pool boiling phenomenon and different regimes of pool boiling.
11. Experiment on pool boiling
12. Determine the emissivity of the test plate surface.
13. Experiment on Stefan-Boltzmann apparatus
14. Determine the heat transfer rate coefficient in fluidized bed apparatus.

Virtual Lab:-

1. Determination of thermal conductivity of a metal rod
<https://sites.google.com/view/vlab-bnmitmech/home/heat-transfer-lab/determination-of-thermal-conductivity-of-a-metal-rod>
2. Natural Convection heat transfer
<https://sites.google.com/view/vlab-bnmitmech/home/heat-transfer-lab/natural-convection>
3. Heat Transfer by Radiation
<https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=802&cnt=1>
4. Heat transfer by Conduction
<https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=801&cnt=1>
5. The Study of phase change
<https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=709&cnt=1>
6. Black Body Radiation: Determination of Stefan's Constant
<https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=548&cnt=1>
7. Newton's Law of Cooling
<https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=354&cnt=1>
8. Lee's Disc Apparatus
<https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=353&cnt=1>
9. Thermo Couple-Seebeck Effect
10. <https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=351&cnt=1>



References:

1. Abdul Matheen, Heat Transfer Laboratory Manual, Laxmi Publications; 2/e, 2007.

Online Learning Resources/Virtual Labs:

- <https://sites.google.com/view/vlab-bnmitmech/home/heat-transfer-lab>
- https://www.iare.ac.in/sites/default/files/lab1/IARE_HT_LAB_MANUAL.pdf
- [https://mrcet.com/downloads/digital_notes/ME/III%20year/\(R18A0388\)Heat%20Transfer%20Lab.pdf](https://mrcet.com/downloads/digital_notes/ME/III%20year/(R18A0388)Heat%20Transfer%20Lab.pdf)
- <https://mrcet.com/downloads/ME/Mech%20III-II.pdf>



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(20A03609) 3D PRINTING PRACTICE
(Skill Oriented Course-IV)

Course Objectives:

Students undergoing this course would

- Understand different methods of 3D Printing.
- Gain knowledge about simulation of FDM process
- Estimate time and material required for manufacturing a 3D component

Course Outcomes:

Upon the successful completion of course, students will be able to

- Explain different types of 3d Printing techniques
- Identify parameters for powder binding and jetting process
- Determine effective use of ABS material for 3D Printing
- Apply principles of mathematics to evaluate the volume of material require.

Module 1:

Introduction to Prototyping, Working of 3D Printer, Types of 3D printing Machines:

Exp 1: Modelling of Engineering component and conversion of STL format.

Exp 2: Slicing of STL file and study of effect of process parameter like layer thickness, orientation, and infill on build time using software.

Exercise 1 : Component-1

Exercise 2 : Component-2

Module 2:

Exp 1 : 3D Printing of modelled component by varying layer thickness.

Exp 2 : 3D Printing of modelled component by varying orientation.

Exp 3: 3D Printing of modelled component by varying infill.

Module 3:

Study on effect of different materials like ABS, PLA, Resin etc, and dimensional accuracy.

Module 4:

Identifying the defects in 3D Printed components.

Module 5

Exp1: Modelling of component using 3D Scanner of real life object of unknown dimension in reverse engineering.

Exp 2: 3D Printing of above modelled component.

References:

1. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 1/e, Springer, 2010.
2. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 2/e, World Scientific Publishers, 2003.

Online Learning Resources/Virtual Labs:

- <https://www.hubs.com/knowledge-base/introduction-fdm-3d-printing/>
- <https://slideplayer.com/slide/6927137/>
- <https://www.mdpi.com/2073-4360/12/6/1334>
- <https://www.centropiaggio.unipi.it/sites/default/files/course/material/2013-11-29%20-%20FDM.pdf>
- <https://lecturenotes.in/subject/197>
- https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdf-compressed.pdf
- https://www.vssut.ac.in/lecture_notes/lecture1517967201.pdf
- <https://www.youtube.com/watch?v=NkC8TNts4B4>



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(20A99601) INTELLECTUAL PROPERTY RIGHTS AND PATENTS
(Mandatory Non-Credit Course)

Course Objectives:

This course introduces the student to the basics of Intellectual Property Rights, Copy Right Laws, Cyber Laws, Trade Marks and Issues related to Patents. The overall idea of the course is to help and encourage the student for startups and innovations

Course Outcomes:

- Understand IPR law & Cyber law
- Discuss registration process, maintenance and litigations associated with trademarks
- Illustrate the copy right law
- Enumerate the trade secret law.

UNIT I

Introduction to Intellectual Property Law – Evolutionary past – Intellectual Property Law Basics – Types of Intellectual Property – Innovations and Inventions of Trade related Intellectual Property Rights – Agencies Responsible for Intellectual Property Registration – Infringement – Regulatory – Overuse or Misuse of Intellectual Property Rights – Compliance and Liability Issues.

UNIT II

Introduction to Copyrights – Principles of Copyright – Subject Matters of Copyright – Rights Afforded by Copyright Law – Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works – Rights of Distribution – Rights of performers – Copyright Formalities and Registration – Limitations – Infringement of Copyright – International Copyright Law-Semiconductor Chip Protection Act.

UNIT III

Introduction to Patent Law – Rights and Limitations – Rights under Patent Law – Patent Requirements – Ownership and Transfer – Patent Application Process and Granting of Patent – Patent Infringement and Litigation – International Patent Law – Double Patenting – Patent Searching – Patent Cooperation Treaty – New developments in Patent Law- Invention Developers and Promoters.

UNIT IV

Introduction to Trade Mark – Trade Mark Registration Process – Post registration procedures – Trade Mark maintenance – Transfer of rights – Inter parties Proceedings – Infringement – Dilution of Ownership of Trade Mark – Likelihood of confusion – Trade Mark claims – Trade Marks Litigation – International Trade Mark Law.

UNIT V

Introduction to Trade Secrets – Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreement – Trade Secret Law – Unfair Competition – Trade Secret Litigation – Breach of Contract – Applying State Law. Introduction to Cyber Law – Information Technology Act – Cyber Crime and E-commerce – Data Security – Confidentiality – Privacy – International aspects of Computer and Online Crime.

Textbooks:

1. Deborah E.Bouchoux: “Intellectual Property”. Cengage learning, New Delhi
2. Kompal Bansal & Parishit Bansal “Fundamentals of IPR for Engineers”, BS Publications (Press)
3. Cyber Law. Texts & Cases, South-Western’s Special Topics Collections

References:

1. Prabhuddha Ganguli: ‘ Intellectual Property Rights’ Tata Mc-Graw – Hill, New Delhi
2. Richard Stim: “Intellectual Property”, Cengage Learning, New Delhi.
3. R. Radha Krishnan, S. Balasubramanian: “Intellectual Property Rights”, Excel Books. New Delhi.
4. M. Ashok Kumar and Mohd. Iqbal Ali: “Intellectual Property Right” Serials Pub.



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(20A03701a) MODERN MANUFACTURING METHODS
(Professional Elective-III)

Course Objectives:

- Define various Modern Machining Processes.
- Acquire knowledge in the elementary mechanism and machinability of materials with different Modern Machining Processes.
- Determine basic principles of operation for each process and their applications.
- State various parameters influencing MRR in Non – Traditional Machining Process.
- Classify and understand the working of Additive Manufacturing Processes.

Course Outcomes:

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

- Illustrate advanced machining processes, cutting tools and cutting fluids for a specific material and part features.
- Classify the mechanism of Mechanical Energy based machining processes, its applications and limitations.
- Differentiate Electrical Energy Based machining processes, mechanism of metal removal, machine tool selection.
- Interpret Electro Chemical machining process, economic aspects of ECM and problems on estimation of metal removal rate.

UNIT I Non – Traditional Machining Processes

Non – Traditional Machining Processes: Introduction, Need, Classification and Brief Overview, Considerations in Process selection, Materials, Applications.

Mechanical Energy Based Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultra Sonic Machining – Working Principle, Description of Equipment, Process Parameters, Metal Removal Rate, Applications, Advantages and Limitations.

UNIT II Electrical Energy Based Processes:

Electric Discharge Machining – Working Principles, Description of Equipment, Process Parameters, Surface Finish and MRR, Electrode / Tool, Power and Control Circuits, Tool Wear, Dielectric Fluid, Flushing, Advantages, Limitations and Applications. Wire cut EDM – Working Principle and Applications.

UNIT III Chemical and Electro Chemical Energy Based Processes:

Chemical Machining and Electro Chemical Machining – Working Principle, Description of Equipment, Etchants, Maskants, Techniques of Applying Maskants, Process Parameters, Surface Finish and MRR, Electro Chemical Grinding, Electro Chemical Honing, Applications, Advantages and Limitations.

UNIT IV Thermal Energy Based Processes

Laser Beam Machining and Drilling, Plasma Arc Machining, Electron Beam Machining – Working Principle, Description of Equipment, Process Parameters, Applications, Advantages and Limitations.

UNIT V Additive Manufacturing

Introduction to Additive Manufacturing, Classification of Additive Manufacturing Processes, Working Principle, Advantages, Limitations and Applications of Stereolithography (SLA), Fused Deposition Modeling, Selective Laser Sintering, Laminated Object Manufacturing

Textbooks:

1. Jain V.K., Advanced Machining Processes, 1st Edition, Allied Publishers Pvt. Ltd., New Delhi, 2007.
2. Pandey P.C and Shan H.S., Modern Machining Processes, 1/e, McGraw Hill, New Delhi, 2007.
3. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 1/e, Springer, 2010.



Reference Books:

1. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 2/e, World Scientific Publishers, 2003.
2. Benedict G.F., Nontraditional Manufacturing Processes, 1/e, CRC Press, 1987.
3. Mishra P.K., Nonconventional Manufacturing, 1/e, Narosa Publishing House, New Delhi, 2014.
4. McGeough J.A., Advanced Methods of Machining, 1/e, Springer, 1988.

Online Learning Resources:

- <https://nptel.ac.in/courses/112/107/112107078/>
- https://youtu.be/t3y_Ys3LgGM
- https://www.youtube.com/watch?v=E4VZ_rFqpG4&t=1s
- https://youtu.be/-tcaR7oSx_w
- <https://youtu.be/Uybg6VDLoRQ>
- <https://youtu.be/Uybg6VDLoRQ>
- <https://youtu.be/aWQsEX1TrSI>



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(20A03701b) DESIGN FOR MANUFACTURING
(Professional Elective-III)

Course Objectives:

- Explain the product development cycle and manufacturing issues to be considered in design.
- Familiarize manufacturing consideration in cast, forged, and weld components.
- Describe the manufacture of sheet metal components.
- Impart knowledge plastics as substitution to metallic parts.

Course Outcomes: After successful completion of the course, the student will be able to

- Design mechanical components with economical consideration
- Select materials and machining processes
- Identify the necessity for redesigning components out of manufacturing considerations
- Consider the manufacturing considerations while designing cast, forged weld and sheet metal components
- Design plastic parts with manufacturing considerations

UNIT I Introduction

Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design.

Materials: Selection of materials for design-developments in material technology-criteria for material selection-material selection interrelationship with process selection-process selection charts.

UNIT II Machining processes:

Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease –redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT III Metal Casting and Joining

Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints.

UNIT IV Forging, Extrusion & Sheet metal work

Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

UNIT V Plastics

Visco elastic and creep behavior in plastics-design guidelines for plastic components-design considerations for injection moulding – design guidelines for machining and joining of plastics.

Textbooks:

1. George E Dieter and Linda Schmidt, Engineering Design, 4/e, McGraw Hill, 2015.
2. A.K.Chitale and R.C.Gupta, Product Design and Manufacturing, 5/e, PHI Learning 2011.
3. David M Anderson, Design for Manufacturability, CRC Press, 2013.

Reference Books:

1. James G Bralla, Design For Manufacturability Handbook, 2/e, McGraw Hill, 2004.
2. Dr.P.C.Sharma, Production Technology, S.Chand & Company, 2009.
3. G. Boothroyd, Product Design for Manufacture & Assembly, CRC Press, 3/e, 2010.



Online Learning Resources:

- <https://nptel.ac.in/courses/112/101/112101005/>
- https://www.iare.ac.in/sites/default/files/lecture_notes/DFMA_Lecture_NOTES.pdf
- <https://ocw.mit.edu/courses/mechanical-engineering/2-008-design-and-manufacturing-ii-spring-2004/lecture-notes/>
- <https://dokumen.tips/documents/design-for-manufacturing-and-assembly-1-lecture-notes-on-design-for-manufacturing.html>
- <https://www.youtube.com/watch?v=ofmbhbVCUqI>
- https://onlinecourses.nptel.ac.in/noc21_me66/preview



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– IV-I Sem

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(20A03701c) OPERATIONS RESEARCH
(Professional Elective-III)

Course Objectives:

- To impart the basic concepts of modelling, models and statements of the operations research.
- Formulate and solve linear programming problem/situations.
- Model strategic behaviour in different economic situations.
- To solve transportation problems to minimize cost.
- Apply Queuing theory to solve problems of traffic congestion, counters in banks, railway bookings etc.
- Explain scheduling and sequencing of production runs and develop proper replacement policies.

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

- Develop mathematical models for practical problems. (L3)
- Apply linear programming to transportation problems. (L3)
- Solve games using various techniques. (L3)
- Solve production scheduling and develop inventory policies. (L6)
- Apply optimality conditions for constrained and unconstrained nonlinear problems. (L3)
- Apply dynamic programming methods. (L3)

UNIT I Introduction to OR

Introduction to Operations Research (OR): OR definition - Classification of Models, modeling – Methods of solving OR Models, limitations and applications of OR models

Linear Programming(LP): Problem Formulation, Graphical Method, Simplex Method, Big-M Method, Two-Phase Simplex Method, Special Cases of LP- Degeneracy, Infeasibility and Multiple Optimal Solutions; Concept of dual theorem

UNIT – II Transportation and Assignment Problems

Transportation Problem – Formulation; Different Methods of Obtaining Initial Basic Feasible Solution –North West Corner Rule, Least Cost Method, Vogel's Approximation Method; Optimality Method – Modified Distribution (MODI) Method; Special Cases – Unbalanced Transportation Problem, Degenerate Problem. Assignment Problem – Formulation, Hungarian Method for Solving Assignment Problems, Traveling Salesman problem.

UNIT – III Game theory & Job Sequencing:

Game theory: Optimal solution of two person zero sum games, the max min and min max principle. Games without saddle points, mixed strategies. Reduction by principles of dominance, arithmetic, algebraic method and graphical method.

Job Sequencing: Introduction to Job shop Scheduling and flow shop scheduling, Solution of Job Sequencing Problem, Processing of n Jobs through two machines, Processing of n Jobs through m machines, graphical method.

UNIT – IV Queuing Theory & Inventory Control

Queuing Theory: Introduction – Terminology, Arrival Pattern, Service Channel, Population, Departure Pattern, Queue Discipline, Birth & Death Process, Single Channel Models with Poisson Arrivals, Exponential Service Times with infinite and finite queue length; Multichannel Models with Poisson Arrivals, Exponential Service Times with infinite queue length.

Inventory Control: Introduction, Deterministic models – EOQ model with and without shortages, Production model, Buffer stock and discount inventory models with single price breaks. Selective inventory control.

UNIT – V Replacement and Maintenance Analysis & DP

Replacement and Maintenance Analysis: Introduction – Types of Maintenance, Make or buy decision. Types of Replacement Problems, Determination of Economic Life of an Asset, and Simple Probabilistic Model for Items which completely fail-Individual Replacement Model, Group Replacement Model. **Dynamic Programming (DP):** Introduction –Bellman's Principle of Optimality – Applications of Dynamic Programming – Shortest Path Problem – Capital Budgeting Problem –



Solution of Linear Programming Problem by DP.

Textbooks:

1. Sharma S.D., Operations Research: Theory, Methods and Applications, 15/e, Kedar Nath Ram Nath, 2010
2. Taha H.A., Operations Research, 9/e, Prentice Hall of India, New Delhi, 2010.

Reference Books:

1. Hiller F.S., and Liberman G.J., Introduction to Operations Research, 7/e, Tata McGraw Hill, 2010.
2. Sharma J.K., Operations Research: Theory and Applications, 4/e, Laxmi Publications, 2009.
3. Prem kumar Gupta and Hira, Operations Research, 3/e, S Chand Company Ltd., New Delhi, 2003.
4. Pannerselvam R., Operations Research, 2/e, Pentice Hall of India, New Delhi, 2006.
5. Sundaresan.V, and Ganapathy Subramanian.K.S, Resource Management Techniques: Operations Research, A.R Publications, 2015.

Online Learning Resources:

- <http://www2.informs.org/Resources/>
- <http://www.mit.edu/~orc/>
- <http://www.ieor.columbia.edu/>
- <http://www.universalteachpublications.com/univ/ebooks/or/Ch1/origin.htm>
- <http://www.wolfram.com/solutions/OperationsResearch/>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– IV-I Sem **L T P C**
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(20A03702a) AUTOMOBILE ENGINEERING
(Professional Elective-IV)

Course Objectives:

- Impart the knowledge of vehicle structure and its components.
- Demonstrate various components of petrol engines and diesel engines.
- Trains about the various electrical system, circuits, and testing of automobiles.
- Explain the concepts of steering, suspension and braking system in automobile.

Course Outcomes: After successful completion of this course, the student will be able to

- Identify different parts of automobile
- Explain the working of various parts like engine and brakes
- Describe the working of steering and the suspension systems.
- Summarize the wheels and tires
- Outline the future developments in the automobile industry

UNIT I Introduction to vehicle structure and engine components:

Vehicle construction - Chassis and body - Specifications - Engine - Types - Construction - Location of engine - Cylinder arrangement - Construction details - Cylinder block - Cylinder head - Cylinder liners - Piston – piston rings - Piston pin - Connecting rod - Crankshaft - Valves. Lubrication system - Types - Oil pumps - Filters. Crankcase ventilation.

UNIT II Ignition and fuel supply systems:

Ignition system - Coil and Magneto - Spark plug - Distributor – Electronic ignition system - Fuel system - Carburetor - Fuel pumps - Fuel injection systems - Mono point and Multi point – Unit Injector – Nozzle types - Electronic Fuel Injection system (EFI) – GDI, MPFI, DTSI.

UNIT – III Steering and suspension system:

Principle of steering - Steering Geometry and wheel alignment - Steering linkages – Steering gearboxes - Power steering - front axle - Suspension system - Independent and Solid axle – coil, leaf spring and air suspensions - torsion bar - shock absorbers.

UNIT – IV Wheels, Tyres and Braking System:

Wheels and Tyres - Construction - Type and specification - Tyre wear and causes - Brakes - Needs – Classification –Drum and Disc Mechanical - Hydraulic and pneumatic - Vacuum assist – Retarders – Anti-lock Braking System(ABS).

UNIT – V Automobile electrical systems and advances in automobile engineering:

Battery-General electrical circuits- Active Suspension System (ASS) - Electronic Brake Distribution (EBD) – Electronic Stability Program(ESP), Traction Control System (TCS) - Global Positioning System (GPS), Hybrid vehicle, Fuel Cell.

Textbooks:

1. Kirpal Singh, Automobile Engineering, Vol.1&2, Standard Publications, 13/e, 2020.
2. William.H.Crouse, Automotive Mechanics, 10/e , McGraw-Hill, 2006.
3. David A. Corolla, Automotive Engineering: Powertrain, Chassis System and Vehicle Body, Butterworth-Heinemann Publishing Ltd, 2009.
4. Richard Stone, Jeffrey K. Ball, Automotive Engineering Fundamentals" SAE International, 2004.

Reference Books:

1. Bosch, Automotive Hand Book, 6/e, SAE Publications, 2007.
2. K. Newton and W. Steeds, The motor vehicle, 13/e, Butterworth-Heinemann Publishing Ltd, 1989.
3. Joseph Heitner, Automotive Mechanics Principles and Practices, 2/e, CBS publishing 2004.



Online Learning Resources:

- <https://nptel.ac.in/courses/107106088>
- <https://nptel.ac.in/courses/107106080>
- <https://hindustanuniv.ac.in/assets/pdf/ug/CBCS/cbcs-automobile-2018.pdf>
- https://ed.iitm.ac.in/~shankarram/Course_Files/ED5160/ED5160.htm
- https://dbatu.ac.in/wp-content/uploads/2020/07/B-Tech-Automobile_Final-Yr_22.06.2020-1.pdf
- <https://www.youtube.com/channel/UCGLlbmSTaLNUPhDwsMe-SgQ>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– IV-I Sem

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(20A03702b) MECHANICAL VIBRATIONS
(Professional Elective-IV)

Course Objectives:

- Demonstrate basic concepts and definitions of mechanical vibrations. To write equation of motion for discrete spring-mass systems with different configuration using classical and energy methods.
- To train the students about basic concepts of forced vibrations, vibration transmissibility and isolation and seismic instruments. Further to understand about various vibration control methods.
- To familiarize the students about two degree freedom system and various types of vibration absorbers.
- To analyze the two degree and multi degree of freedom systems.

Course Outcomes: After successful completion of the course, the student will be able to

- Find natural frequency of un-damped single degree freedom systems
- Analyze the two degree freedom systems with and without damping
- Calculate transmissibility and isolation
- Solve problems on vibration absorber
- Calculate natural frequencies of multi degree freedom system
- Measure vibration parameters
- Use mechanical exciters and electro dynamic shaker

UNIT I Single Degree Freedom Systems

Single Degree Freedom Systems: Un-damped free vibration: Classical method, Energy method, equivalent systems, torsional systems. Damped free vibration- Viscous damping, under damping, critical damping, over damping. Coulomb damping, equivalent damping coefficient. Simple problems.

Whirling of shafts: Transverse vibrations: Dunkerley's lower bound approximation, Critical speed of shafts.

UNIT II Forced vibrations of Single Degree Freedom Systems

Steady state forced vibration, sources of excitation, impressed harmonic force, resonance impressed force due to unbalance, motion excitation, transmissibility and isolation, performance of different type of isolators, power absorbed by viscous damping.

UNIT III Two Degree Freedom Systems:

Formulation of Equation of motion, Natural frequencies and modes of vibration by classical method, coupled pendulum, forced vibration, dynamic vibration absorber.

UNIT IV Multi Degree Freedom Systems:

Lagrangian method for formulation of equation of motion Influence co- efficient method, Lumped mass and distributed mass systems, Stodola method, Holzer's method, model analysis of free and forced vibrations.

UNIT V Vibration measurement and Applications

Transducers: variable resistance transducers, Piezoelectric transducers, electro dynamic transducers and linear variable differential transformer transducer; Vibration pickups: vibrometer, accelerometer, velometer and phase distortion; Frequency-measuring instruments; Vibration exciters- Mechanical exciters and electro dynamic shaker.

Textbooks:

1. Singiresu S. Rao, Mechanical Vibrations, 6/e, Pearson Education, 2018.
2. G.K.Groover, Mechanical Vibrations, Nem chand & Bro, 8/e, 2009.

Reference Books:

1. L. Meirovich, Elements of Vibrations Analysis, Tata McGraw Hill, 1986.
2. S. Graham Kelly, Mechanical Vibrations, Tata McGraw Hill, 1996
3. William Thomson, Theory of Vibrations with Applications, 5/e, Pearson, 2008
4. William Weaver, Timeoshenko, and Young, Vibration Problems in Engineering, 5/e, John Wiley, 2013.



5. C. Nataraj, Vibration of Mechanical Systems, 1/e, Cenage Learning, 2012.

Online Learning Resources:

- <https://nptel.ac.in/courses/112107212>
- <https://nptel.ac.in/courses/112103111>
- <https://nptel.ac.in/courses/112103112>
- <https://nptel.ac.in/courses/101105081>
- <https://www.iare.ac.in/sites/default/files/PPT/MVSD%20PPT.pdf>
- https://www.iare.ac.in/sites/default/files/lecture_notes/MV_LECTURE_NOTES.pdf



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– IV-I Sem

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(20A03702c) REFRIGERATION AND AIR CONDITIONING
(Professional Elective-IV)

Course Objectives:

- Provides insights in how thermodynamic principles are applied within the refrigeration and air conditioning industry.
- Introduce the students how real systems used in commercial, industrial refrigeration and air conditioning industries are built-up.
- Expose the students on various refrigeration methods like VCR, VAR and latest developments.
- Know the various air conditioning methods like summer, winter and year round air conditioning and to make the student to understand the practical applications of refrigeration and air conditioning systems.

Course Outcomes: At the end the student will be able to

- Appraise the importance of humidifiers and dehumidifiers
- Select the requirements of temperature and humidity for human comfort
- Demonstrate the heat pump working and its components
- List the various air conditioning equipments

UNIT I

Introduction to Refrigeration

Necessity and Applications, Carnot Refrigerator, First and Second Law Applied to Refrigerating Machines, Unit of Refrigeration, COP, EER, Different Refrigeration Methods.

Air Refrigeration: Bell-Coleman Cycle, Ideal and Actual Cycles, Open and Dense Air Systems - Numerical Problems - Refrigeration Needs of Air Crafts.

UNIT II Vapour Compression Refrigeration (VCR) System

Vapour Compression Refrigeration (VCR) System - Basic Cycle - Working Principle and Essential Components of the Plant - COP - Representation of Cycle On T-S and P-h Charts - Expander Vs. Throttling, Effect of Sub Cooling and Super Heating - Cycle Analysis - Actual Cycle- Influence of Various Parameters on System Performance - Construction and Use of P-h Charts - Numerical Problems. Refrigerants - Desirable Properties - Classification of Refrigerants Used - Nomenclature- Secondary Refrigerants- Lubricants - Ozone Depletion - Global Warming- Newer Refrigerants.

UNIT III Vapor Absorption Refrigeration (VAR) System

Vapor Absorption Refrigeration (VAR) System-Description and Working of NH₃ - Water System and Li Br -Water (Two Shell & Four Shell) System -Calculation of Max COP, Principle of Operation of Three Fluid Absorption System

STEAM JET REFRIGERATION SYSTEM: Working Principle and Basic Components-Estimation of Motive Steam Required Principle and Operation of: (I) Thermo-Electric Refrigerator (ii) Vortex Tube or Hilsch Tube.

UNIT IV Introduction to Air Conditioning:

Psychrometric Properties & Processes - Characterization of Sensible and Latent Heat Loads - Need For Ventilation, Consideration of Infiltrated Air - Heat Load Concepts. Air Cooler (Evaporative Cooling) ,Window, Split, Summer , Winter, Year Round, Central Air Conditioning Systems.

UNIT V Air Conditioning Equipment

Air Conditioning Equipment - Humidifiers - Dehumidifiers - Air Filters, Fans and Blowers. Human Comfort: Requirements of Temperature, Humidity And Concept of Effective Temperature, Comfort Chart. Heat Pump - Heat Sources - Different Heat Pump Circuits.

Textbooks:

1. Refrigeration and Air Conditioning, C P Arora, TMH, 15/e, 2013.
2. S. C Arora & Domkundwar, A Course in Refrigeration and Air conditioning, Dhanpat rai & Co, 2018.



Reference Books:

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age, 2/e, 2013
2. Principles of Refrigeration - Dossat / Pearson Education, 4/e, 2007
3. Refrigeration and Air Conditioning-P.L.Ballaney, 2/e, 2012.
4. Basic Refrigeration and Air-Conditioning - P.N.Ananthanarayanan / TMH, 4/e, 2013.

NOTE: Tables/Codes: Thermal Engineering Data Book containing refrigerant and Psychrometric property Tables and charts are permitted in Exam

Online Learning Resources:

- https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_RAC_Lecture_Notes.pdf
- <https://www.studocu.com/en-us/document/saint-louis-university/fluid-dynamics-laboratory/refrigeration-lecture-notes-1/3020577>
- <http://home.iitk.ac.in/~samkhan/ME340A.htm>
- <https://nptel.ac.in/courses/112105129>
- <http://dte.karnataka.gov.in/Institutes/gptkampli/GenericDocHandler/68-fc177b7d-f5d1-4580-b577-b1118df994f4.pdf>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– IV-I Sem
(20A03703a) MECHATRONICS AND MEMS
(Professional Elective-V)

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Course Objectives:

- Familiarize the technologies behind modern mechatronic systems.
- Explain fundamentals for the development of fully automated system.
- Develop a robotic or automated systems focusing on the hardware and software integration.
- Demonstrate the development of mechatronic system and MEMS.

Course Outcomes: At the end the student will be able to

- Demonstrate the knowledge of MEMS
- Classifying different fabrication techniques of MEMS
- Illustrate the application of MEMS in industry

UNIT I Introduction

Definition of Mechatronics, Need for Mechatronics in Industry, Objectives of mechatronics, mechatronics design process, Mechatronics key elements, mechatronics applications – Computer numerical control (CNC) machines, Tool monitoring systems, Flexible manufacturing system (FMS), Industrial Robots, Automatic packaging systems, Automatic inspection systems.

UNIT II Sensors

Static and dynamic characteristics of sensors, Displacement, Position and Proximity sensors, Force and torque sensors, Pressure sensors, Flow sensors, Temperature sensors, Acceleration sensors, Level sensors, Light sensors, Smart material sensors, Micro and Nano sensors, Selection criteria for sensors.

UNIT III Actuators

Mechanical, Electrical, Hydraulic and Pneumatic Actuation systems, Characteristics and their limitations, Design of Hydraulic and Pneumatic circuits, Piezoelectric actuators, Shape memory alloys, Selection criteria for actuators.

UNIT IV Microprocessors, Microcontrollers and Programmable Logic Controllers:

Architecture of Microprocessor, Microcontroller and Programmable Logic Controller, PLC Programming using ladder diagrams, logics, latching, sequencing, timers relays and counters, data handling, Analog input/output, selection of controllers.

UNIT V Micro Electro Mechanical Systems (MEMS)

History, Effect of scaling, Fabrication Techniques: Oxidation, Physical Vapor deposition, Chemical Vapor Deposition, Lithography, Etching, Wafer bonding, LIGA, DRIE, Applications: Lab on chip.

Textbooks:

1. W. Bolton, Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, 3/e, Pearson Education Press, 2005.
2. Devadas Shetty and Richard A Kolk, Mechatronic System Design, 2/e, Cengage learning, 2010.
3. N. Mahalik, MEMS, McGraw Hill Educations, 2017.

Reference Books:

1. Clarence W. de Silva, Mechatronics an Integrated Approach, CRC Press, 2004.
2. James J Allen, Micro Electro Mechanical Systems Design, CRC Press Taylor & Francis group, 2005.
3. Ganesh S Hedge, Mechatronics, Jones & Bartlett Learning, 2010.
4. Mohammed Gad, MEMS; Design and Fabrication, CRC Press, 2010.

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc22_me54/preview
- <https://nptel.ac.in/courses/112108092>
- <https://nptel.ac.in/courses/112101304>
- https://onlinecourses.nptel.ac.in/noc20_ee56/preview



- https://www.cet.edu.in/noticefiles/259_Lecturer%20Note%20on%20Mechatronics-ilovepdf-compressed.pdf, <https://lecturenotes.in/subject/1176/mechatronics-and-mems>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– IV-I Sem

L	T	P	C
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(20A03703b) DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS
(Professional Elective-V)

Course Objectives:

- Familiarize on Fluid Power Engineering and Power Transmission System.
- Introduce the students, the basic concepts of hydraulic and pneumatic systems.
- Expose the students with various hydraulic and pneumatic actuators.
- Familiarize on fluid power systems and its applications to real time.
- Know the problem, which occur in fluid power systems and take necessary troubleshooting/ maintenance activities.
- Get practiced in designing hydraulic and pneumatic systems.
- Understand the design procedure available for Hydraulic and Pneumatic circuits.

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

- Compare the differences between hydraulic and pneumatic systems
- Identify the practical applications in automation
- Build the circuits for a given applications
- Develop hydraulic and pneumatic power packs
- Discuss the importance of PLC and microprocessor in hydraulic and pneumatic systems

UNIT I Introduction

Introduction to fluid power - Types, advantages and application of fluid power systems. Properties of hydraulic fluids – General types of fluids – Fluid power symbols as per ISO/ANSI. Basic Components of Hydraulic and Pneumatic Systems. Comparison of Mechanical, Electrical, Hydraulic & Pneumatic systems for force and motion analysis in automation.

UNIT – II

Hydraulic Pumps, Actuators:Types of hydraulic pumps - construction and working principle - design considerations, selection, specifications and characteristics of pumps. Types of actuators- construction and working principle - design considerations, selection, specifications and characteristics of actuators.

Control And Regulation Elements: Direction control valves, Pressure control valves, Flow control valves, Non-return valves, Reservoirs, Accumulators, Heating & cooling devices, Hoses. Selection of valves for hydraulic circuits.

UNIT – III Design Of Hydraulic Circuits

Speed control circuits - Regenerative circuits- Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier–Intensifier circuit. - Reservoir design - Selection of components. Hydraulic circuits - Reciprocating - Quick return - Sequencing synchronizing - Safety circuits - Industrial circuits - Press - Milling Machine - Planner - Fork Lift.

UNIT – IV Pneumatic Systems

Pneumatic fundamentals - Properties of air – Compressors – Filter, Regulator, and Lubricator unit – Air control valves, Quick exhaust valves, and pneumatic actuators. Control Elements - Logic Circuits -Position - Pressure Sensing - Switching – Electro Pneumatic - Electro Hydraulic Circuits - Robotic Circuits.

UNIT – V Design Of Pneumatic Circuits

Classic-Cascade-Step counter - Combination -Methods - PLC-Microprocessors -Uses - Selection criteria for Pneumatic components - Installation and Maintenance of Hydraulic and Pneumatic power packs - Fault finding - Principles of Low Cost Automation - Case studies.

Textbooks:

1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education 2000.
2. Majumdar S.R, “Oil Hydraulics”, Tata McGraw Hill, 2000.
3. Majumdar S.R, “Pneumatic Systems – Principles and Maintenance”, Tata McGraw Hill, 2001.



Reference Books:

1. Andrew Parr, Hydraulic & Pneumatics, 2/e, Jaico Publishing House Elsevier, 1999.
2. Harry L. Stevart D.B, "Practical Guide to Fluid Power", Taraoeala Sons and Port Ltd. Broadey, 1976.
3. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

Online Learning Resources:

- Chrome-extension://efaidnbmnnibpcaglfindmkaj/viewer.htm?pdfurl=https%3A%2F%2Fwww.iare.ac.in%2Fsites%2Fdefault%2Ffiles%2FDHPS%2520LECTURER%2520NOTES%2520FINAL.pdf&chunk=true.
- chromeextension://efaidnbmnnibpcaglfindmkaj/viewer.html?pdfurl=https%3A%2F%2Fwww.iare.ac.in%2Fsites%2Fdefault%2Ffiles%2FDHPS%2520PPT%2520%2520FINAL.pdf&chunk=true.
- <https://nptel.ac.in/courses/112/105/112105047/>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– IV-I Sem

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(20A03703c) GEOMETRIC DIMENSIONING AND TOLERANCES
(Professional Elective-V)

Course Objectives:

- Teach the basics of the geometric dimensioning and tolerances.
- Familiar with five groups of GD&T tolerances, form, orientation, location, runout and profile tolerances.
- Introduce tolerances of profiles of lines and surfaces with or without datums.
- Expose the students to various surface roughness parameters and their measurements in two dimensions.
- Understand the concepts of dimensional chains and inspection techniques.

Course Outcomes:

- This course systematically introduces the essentials of the language of geometric dimensioning and tolerancing (GD&T) based on ASME standards, as well as the essentials of surface roughness measurements in both 2D and 3D including filtering techniques.
- This course also introduces the related concepts of Vectorial dimensioning and tolerancing, dimensional chains, measurement uncertainty, etc.
- The knowledge gained by the students by learning the above topics will help them to perform very well in their profession as metrologists as well as product designers.

UNIT I Basic Concepts

General terms and definitions of geometrical features - General principle of sizes - System of limits and fits - Inspection of dimensional and geometrical deviations - Datums, datum systems, and selection of datums. Restraining degrees of freedom, DOF, Simulators. Rule #1(Boundary principle) and Rule #2.

UNIT II Form and Orientation Tolerances

Principles of dimensioning - Introduction to geometric dimensioning and tolerancing (GD&T); Form tolerances: types, specifications and interpretations - measurement and evaluation of straightness, flatness and roundness - Orientation tolerances: types, specifications and interpretations, and verification of orientation tolerances. Exercises on each group. RFS, MMC and LMC concepts.

UNIT III Location, Runout and Profile Tolerances

Tolerances of location: types, specifications and interpretations - verification techniques - Tolerances of profiles of lines and surfaces with or without datums - Tolerances of runout - Tolerancing of angles and cones. Exercises on each group. RFS, MMC and LMC concepts.

UNIT IV Surface Roughness

Various parameters and their measurements in two dimensions - filtering and filtering techniques - areal parameters, symbology

UNIT V Inspection of GD&T call-outs

Vectorial dimensioning and tolerancing - Statistical tolerancing of mechanical assemblies - Dimensional chains - Measurement uncertainty - Computer-aided tolerancing and verification. Inspection techniques- conventional and CMM.

Textbooks:

1. Drake, P. J., Dimensioning and Tolerance Handbook, McGraw-Hill, Inc., New York. 1999.
2. Meadows, J. D., Geometric Dimensioning and Tolerancing: Applications and Techniques for use in Design, Manufacturing and Inspection, Marcel Dekker, Inc., New York. 1995.
3. Gill, P. S., Geometric Dimensioning and Tolerancing, S. K. Kataria & Sons, New Delhi, 2/e, 2013.
4. ASME 14.5 - 2009 standards,
5. Alex Krulikowski, Fundamentals of geometric dimensioning and tolerancing, Cengage Learning, 3/e, 2012.



6. James D Meadows, —Measurement of Geometric Tolerances in Manufacturing, CRC Press, 1/e, 1998.

Reference Books:

1. Gupta, I. C., A Text book of Engineering Metrology, Dhanpat Rai Publications, New Delhi, 2018.
2. Galyer, J. F. W. and C. R. Shotbolt, Metrology for Engineers, Cassell Publishers, London, 5/e, 1990.
3. Henzold, G., Handbook of Geometrical Tolerancing: Design, Manufacturing and Inspection, John Wiley & Sons, Chichester, 2/e, 2006.
4. Muralikrishnan, B. and J. Raja, Computational Surface and Roundness Metrology, Springer USA, 1/e, 2010.
5. Relevant Indian and International Standards.
6. Whitehouse, D. J., Surfaces and their Measurement, Hermes Penton Science, London, 2002.

Online Learning Resources:

- <https://nptel.ac.in/courses/112/106/112106179/>
- https://www.youtube.com/watch?v=X_VepJhq_vk
- https://www.youtube.com/watch?v=cjzSXPDBA_Q&t=1s
- <https://www.youtube.com/watch?v=-tLq1wXio0U>
- <https://digitaldefynd.com/best-gdt-courses/>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– IV-I Sem
20A52701a) ENTREPRENEURSHIP & INCUBATION
(HUMANITIES ELECTIVE II)

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Course Objectives:

- To make the student understand about Entrepreneurship
- To enable the student in knowing various sources of generating new ideas in setting up of New enterprise
- To facilitate the student in knowing various sources of finance in starting up of a business
- To impart knowledge about various government sources which provide financial assistance to entrepreneurs/ women entrepreneurs
- To encourage the student in creating and designing business plans

Course Outcomes:

- Understand the concept of Entrepreneurship and challenges in the world of competition.
- Apply the Knowledge in generating ideas for New Ventures.
- Analyze various sources of finance and subsidies to entrepreneur/women Entrepreneurs.
- Evaluate the role of central government and state government in promoting entrepreneurship.
- Create and design business plan structure through incubations.

UNIT I

Entrepreneurship - Concept, knowledge and skills requirement - Characteristics of successful entrepreneurs - Entrepreneurship process - Factors impacting emergence of entrepreneurship - Differences between Entrepreneur and Intrapreneur - Understanding individual entrepreneurial mindset and personality - Recent trends in Entrepreneurship.

UNIT II

Starting the New Venture - Generating business idea – Sources of new ideas & methods of generating ideas - Opportunity recognition - Feasibility study - Market feasibility, technical/operational feasibility - Financial feasibility - Drawing business plan - Preparing project report - Presenting business plan to investors.

UNIT III

Sources of finance - Various sources of Finance available - Long term sources - Short term sources - Institutional Finance – Commercial Banks, SFC's in India - NBFC's in India - their way of financing in India for small and medium business - Entrepreneurship development programs in India - The entrepreneurial journey- Institutions in aid of entrepreneurship development

UNIT IV

Women Entrepreneurship - Entrepreneurship Development and Government - Role of Central Government and State Government in promoting women Entrepreneurship - Introduction to various incentives, subsidies and grants – Export- oriented Units - Fiscal and Tax concessions available - Women entrepreneurship - Role and importance - Growth of women entrepreneurship in India - Issues & Challenges - Entrepreneurial motivations.

UNIT V

Fundamentals of Business Incubation - Principles and good practices of business incubation- Process of business incubation and the business incubator and how they operate and influence the Type/benefits of incubators - Corporate/educational / institutional incubators - Broader business incubation environment - Pre-Incubation and Post - Incubation process - Idea lab, Business plan structure - Value proposition

Textbooks:

1. D F Kuratko and T V Rao, “Entrepreneurship” - A South-Asian Perspective – Cengage Learning, 2012. (For PPT, Case Solutions Faculty may visit : login.cengage.com)
2. Nandan H, “ Fundamentals of Entrepreneurship”, PHI, 2013

References:

1. Vasant Desai, “Small Scale Industries and Entrepreneurship”, Himalaya Publishing 2012.
2. Rajeev Roy “Entrepreneurship”, 2nd Edition, Oxford, 2012.



3. B.JanakiramandM.Rizwanal “Entrepreneurship Development: Text & Cases”, Excel Books, 2011.
4. Stuart Read, Effectual “Entrepreneurship”, Routledge, 2013.

E-Resources

1. Entrepreneurship-Through-the-Lens-of-enture Capital
2. <http://www.onlinevideolecture.com/?course=mba-programs&subject=entrepreneurship>
3. http://nptel.ac.in/courses/122106032/Pdf/7_4.pdf
4. <http://freevideolectures.com/Course/3514/Economics-/-Management-/-Entrepreneurhip/50>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– III-II Sem

L T P C
3 0 0 3

(20A52701b) MANAGEMENT SCIENCE
(HUMANITIES ELECTIVE-II)

Course Objectives:

- To provide fundamental knowledge on Management, Administration, Organization & its concepts.
- To make the students understand the role of management in Production
- To impart the concept of HRM in order to have an idea on Recruitment, Selection, Training & Development, job evaluation and Merit rating concepts
- To create awareness on identify Strategic Management areas & the PERT/CPM for better Project Management
- To make the students aware of the contemporary issues in management

Course Outcomes:

- Understand the concepts & principles of management and designs of organization in a practical world
- Apply the knowledge of Work-study principles & Quality Control techniques in industry
- Analyze the concepts of HRM in Recruitment, Selection and Training & Development.
- Evaluate PERT/CPM Techniques for projects of an enterprise and estimate time & cost of project & to analyze the business through SWOT.
- Create Modern technology in management science.

UNIT I INTRODUCTION TO MANAGEMENT

Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor's Scientific Theory-Henry Fayol's principles - Elton Mayo's Human relations - Systems Theory - **Organisational Designs** - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization - Social responsibilities of Management.

UNIT II OPERATIONS MANAGEMENT

Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), Work Study - Statistical Quality Control- Deming's contribution to Quality. **Material Management** - Objectives - Inventory-Functions - Types, Inventory Techniques - EOQ-ABC Analysis - Purchase Procedure and Stores Management - **Marketing Management** - Concept - Meaning - Nature-Functions of Marketing - Marketing Mix - Channels of Distribution - Advertisement and Sales Promotion - Marketing Strategies based on Product Life Cycle.

UNIT III HUMAN RESOURCES MANAGEMENT (HRM)

HRM - Definition and Meaning – Nature - Managerial and Operative functions - Evolution of HRM - Job Analysis - Human Resource Planning(HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection - Process and Tests in Employee Selection - Employee Training and Development - On-the- job & Off-the-job training methods - Performance Appraisal Concept - Methods of Performance Appraisal – Placement - Employee Induction - Wage and Salary Administration

UNIT IV STRATEGIC & PROJECT MANAGEMENT

Definition& Meaning - Setting of Vision - Mission - Goals - Corporate Planning Process - Environmental Scanning - Steps in Strategy Formulation and Implementation - SWOT Analysis - **Project Management** - Network Analysis - Programme Evaluation and Review Technique (PERT) - Critical Path Method (CPM) Identifying Critical Path - Probability of Completing the project within given time - Project Cost- Analysis - Project Crashing (Simple problems).



UNIT V CONTEMPORARY ISSUES IN MANAGEMENT

The concept of Management Information System(MIS) - Materials Requirement Planning (MRP) - Customer Relations Management(CRM) - Total Quality Management (TQM) - Six Sigma Concept - Supply Chain Management(SCM) - Enterprise Resource Planning (ERP) - Performance Management - Business Process Outsourcing (BPO) - Business Process Re-engineering and Bench Marking - Balanced Score Card - Knowledge Management.

Textbooks:

1. A.R Aryasri, “Management Science”, TMH, 2013
2. Stoner, Freeman, Gilbert, Management, Pearson Education, New Delhi, 2012.

References:

1. Koontz & Weihrich, “Essentials of Management”, 6th edition, TMH, 2005.
2. Thomas N.Duenning& John M.Ivancevich, “Management Principles and Guidelines”, Biztantra.
3. Kanishka Bedi, “Production and Operations Management”, Oxford University Press, 2004.
4. Samuel C.Certo, “Modern Management”, 9th edition, PHI, 2005



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– III-II Sem

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(20A52701c) ENTERPRISE RESOURCE PLANNING
(HUMANITIES ELECTIVE-II)

Course Objectives:

- To provide a contemporary and forward-looking on the theory and practice of Enterprise Resource Planning
- To enable the students in knowing the Advantages of ERP
- To train the students to develop the basic understanding of how ERP enriches the Business organizations in achieving a multidimensional growth.
- Impart knowledge about the historical background of BPR
- To aim at preparing the students, technologically competitive and make them ready to self-upgrade with the higher technical skills.

Course Outcomes:

- Understand the basic use of ERP Package and its role in integrating business functions.
- Explain the challenges of ERP system in the organization
- Apply the knowledge in implementing ERP system for business
- Evaluate the role of IT in taking decisions with MIS
- Create reengineered business processes with process redesign

UNIT I

Introduction to ERP: Enterprise – An Overview Integrated Management Information, Business Modeling, Integrated Data Model Business Processing Reengineering(BPR), Data Warehousing, Data Mining, On-line Analytical Processing(OLAP), Supply Chain Management (SCM), Customer Relationship Management(CRM),

UNIT II

Benefits of ERP: Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design-making Capability

UNIT III

ERP Implementation Lifecycle: Pre-evaluation Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation Team Training, Testing, Going Live, End-user Training, Post-implementation (Maintenance mode)

UNIT IV

BPR: Historical background: Nature, significance and rationale of business process reengineering (BPR), Fundamentals of BPR. Major issues in process redesign: Business vision and process objectives, Processes to be redesigned, Measuring existing processes,

UNIT V

IT in ERP: Role of information technology (IT) and identifying IT levers. Designing and building a prototype of the new process: BPR phases, Relationship between BPR phases. MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System.

Textbooks:

1. Pankaj Sharma. “Enterprise Resource Planning”. Aph Publishing Corporation, New Delhi, 2004.
2. Alexis Leon, “Enterprise Resource Planning”, IV Edition, Mc.Graw Hill, 2019

References:

1. Marianne Bradford “Modern ERP”, 3rd edition.
2. “ERP making it happen Thomas f. Wallace and Michael
3. Directing the ERP Implementation Michael w pelphrey



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)– IV-I Sem

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(20A03706) INDUSTRIAL AUTOMATION
(Skill Oriented Course-V)

Course Objectives:

- Introduce basic concepts and principles of Industrial Automation.
- Familiarize with fluid power systems circuits.
- Describe concepts of SCADA software
- Explain the principles of PLC and 8085 microprocessor.
- Expose the students on Mechatronics.

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

- Summarizes the how fluid power system work
- Discuss about SCADA software
- Develop the skills related to predict the output for various programs.
- Explain the concepts of mechatronics

List of Experiments:

Module 1: Design and testing of fluid power circuits to control

Introduction to Fluid power systems, Symbolic representation of hydraulic and pneumatic components.

Tasks:-

1. Pneumatic trainer kit with FRL Unit, Single acting cylinder, push button.
2. Pneumatic training kit with FRL unit, Double acting cylinder, manually actuated DCV.
3. Pneumatic trainer kit with FRL unit, Double acting cylinder, Pilot actuated DCV.
4. Pneumatic trainer kit with FRL unit Double acting cylinder, Double solenoid actuated DCV, DCV with sensor / magnetic reed.
5. Hydraulic power pack with pumps and pressure relief valve.

Module 2:

- Open source SCADA software such as Free SCADA, Open SCADA,
- Indigo SCADA Code Sys Open source for PLC programming and interfacing with real time PLC
- Delta PLC software – free ware and corresponding PLC programming software.
- 8085 Microprocessor Trainer with Power Supply
- Traffic Light Control System

Module 3: Mechatronics

- Experiment on P, PI and PID Controller.
- Simulation of Hydraulic Actuation System.
- Simulation of Pneumatic Actuation System.
- Simulation on Stepper Motor.
- Simulation on Logic gates, decoders and flip-flops.

References:

1. B. Gavali, S. A. Patil and A. R. Koli, "Technology-Based Learning system in Programmable Logic Controller Education," 2016 IEEE Eighth International Conference on Technology for Education (T4E), Mumbai, 2016, pp. 264-265.
2. Groover, Mikell , Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 2014.
3. Lamb, Frank. Industrial Automation: Hands On (English Edition). NC, McGraw-Hill Education, 2013. ISBN 978-0071816458.

Note:- Trainer can use freeware simulation software's.

Online Learning Resources/Virtual Labs:

http://iotmumbai.bharatvidyapeeth.edu/media/pdf/lab_manuals/Manual_EE5I_EIA_22526.pdf

- https://faculty.ksu.edu.sa/sites/default/files/lab-manual_v3.pdf
- <https://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1494&context=eesp>



OPEN ELECTIVES



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-I Sem
(20A01505) BUILDING TECHNOLOGY
(Open Elective-I)

L	T	P	C
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Course Objectives:

- To know different types of buildings, principles and planning of the buildings.
- To identify the termite control measure in buildings, and importance of grouping circulation, lighting and ventilation aspects in buildings.
- To know the different modes of vertical transportation in buildings.
- To know the utilization of prefabricated structural elements in buildings.
- To know the importance of acoustics in planning and designing of buildings.

Course Outcomes (CO):

- Understand the principles in planning and design the buildings
- To get different types of buildings, principles and planning of the buildings
- To know the different methods of termite proofing in buildings.
- Know the different methods of vertical transportation in buildings.
- Know the implementation of prefabricated units in buildings and effect of earthquake on buildings.
- Know the importance of acoustics in planning and designing of buildings.

UNIT I

Overview of the course, basic definitions, buildings-types-components-economy and design-principles of planning of buildings and their importance. Definitions and importance of grouping and circulation-lighting and ventilation-consideration of the above aspects during planning of building.

UNIT II

Termite proofing: Inspection-control measures and precautions-lighting protection of buildings-general principles of design of openings-various types of fire protection measures to be considered while planning a building.

UNIT III

Vertical transportation in a building: Types of vertical transportation-stairs-different forms of stairs-planning of stairs-other modes of vertical transportation –lifts-ramps-escalators.

UNIT IV

Prefabrication systems in residential buildings-walls-openings-cupboards-shelves etc., planning and modules and sizes of components in prefabrication. Planning and designing of residential buildings against the earthquake forces, principles, seismic forces and their effect on buildings.

UNIT V

Acoustics –effect of noise –properties of noise and its measurements, principles of acoustics of building. Sound insulation-importance and measures.

Textbooks:

1. Building construction by Varghese, PHI Learning Private Limited 2nd Edition 2015
2. Building construction by Punmia.B.C, Jain.A.K and Jain.A.K Laxmi Publications 11th edition 2016

Reference Books:

1. National Building Code of India, Bureau of Indian Standards
2. Building construction-Technical teachers training institute, Madras, Tata McGraw Hill.
3. Building construction by S.P.Arora and S.P.BrndraDhanpat Rai and Sons Publications, New Delh 2014 edition
<https://nptel.ac.in/courses/105102206>
<https://nptel.ac.in/courses/105103206>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-I Sem **L T P C**
3 0 0 3

(20A02505) ELECTRIC VEHICLES
(Open Elective-I)

Course Objectives:

- To get exposed to new technologies of battery electric vehicles, fuel cell electric vehicles
- To get exposed to EV system configuration and parameters
- To know about electro mobility and environmental issues of EVs
- To understand about basic EV propulsion and dynamics
- To understand about fuel cell technologies for EV and HVEs
- To know about basic battery charging and control strategies used in electric vehicles

Course Outcomes:

- Understand and differentiate between conventional and latest trends in Electric Vehicles
- Analyze various EV resources, EV dynamics and Battery charging
- Apply basic concepts of EV to design complete EV system
- Design EV system with various fundamental concepts

UNIT I INTRODUCTION TO EV SYSTEMS AND PARAMETERS

Past, Present and Future EV, EV Concept, EV Technology, State-of-the Art EVs, EV configuration, EV system, Fixed and Variable gearing, single and multiple motor drive, in-wheel drives, EV parameters: Weight, size, force and energy, performance parameters.

UNIT II EV AND ENERGY SOURCES

Electro mobility and the environment, history of Electric power trains, carbon emissions from fuels, green houses and pollutants, comparison of conventional, battery, hybrid and fuel cell electric systems

UNIT III EV PROPULSION AND DYNAMICS

Choice of electric propulsion system, block diagram, concept of EV Motors, single and multi motor configurations, fixed and variable geared transmission, In-wheel motor configuration, classification, Electric motors used in current vehicle applications, Recent EV Motors, Vehicle load factors, vehicle acceleration.

UNIT IV FUEL CELLS

Introduction of fuel cells, basic operation, model, voltage, power and efficiency, power plant system – characteristics, sizing, Example of fuel cell electric vehicle.

Introduction to HEV, brake specific fuel consumption, comparison of series, series-parallel hybrid systems, examples

UNIT V BATTERY CHARGING AND CONTROL

Battery charging: Basic requirements, charger architecture, charger functions, wireless charging, power factor correction.

Control: Introduction, modelling of electromechanical system, feedback controller design approach, PI controllers designing, torque-loop, speed control loop compensation, acceleration of battery electric vehicle

Textbooks:

1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

Reference Books:

1. Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, CRC Press 2005.
2. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2015.

Online Learning Resources:



1. https://onlinecourses.nptel.ac.in/noc22_ee53/preview



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-I Sem **L T P C**
3 0 0 3

(20A04505) DIGITAL ELECTRONICS
(Open Elective Course- I)

Course Objectives:

- To provide the fundamental concepts associated with the digital logic and circuit design.
- To introduce the basic concepts and laws involved in the Boolean algebra and logic families and digital circuits.
- To familiarize with the different number systems, logic gates, and combinational and sequential circuits, memory elements utilized in the different digital circuits and systems.
- To introduce different digital logic families

Course Outcomes:

- Become familiar with the Boolean algebra, logic gates, logical variables, the truth table, number systems, codes, and their conversion from to others
- Learn the minimization techniques to simplify the hardware requirements of digital circuits, implement it, design and apply for real time digital systems
- Understand the working mechanism and design guidelines of different combinational, sequential circuits, memory elements and their role in the digital system design.
- Understand different logic families and use the best combination of ICs during the design of a digital system

UNIT 1

DIGITAL FUNDAMENTALS: Number Systems - Decimal, binary, octal, Hexadecimal, 1's and 2's complements, Codes - Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems. Logic gates: Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization.

UNIT II

COMBINATIONAL CIRCUITS: Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

UNIT III

SYNCHRONOUS SEQUENTIAL CIRCUITS: Flip flops - SR, JK, T, D, Master/Slave FF- operation and excitation tables, Triggering of FF, conversion of FF. Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT IV

MEMORY DEVICES: Basic memory structure - ROM, PROM, EPROM, EEPROM, EAPROM, RAM, Static and dynamic RAM. Programmable Logic Devices: Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field Programmable Gate Arrays (FPGA).

UNIT V

Digital Logic Families: Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margin, RTL, TTL, ECL, CMOS.

Textbooks:

1. Modern Digital Electronics (Edition III) : R. P. Jarn; TMH
2. Digital Fundamentals: Thomas I. Floyd
3. Digital circuits and design: S. Salivahanan, and S. Anvzzhagan

References:

1. Digital Integrated Electronics: Taub & Schilling; MGH
2. Digital Design: Morris Mano; PHI Course



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-I Sem
(20A05505a) JAVA PROGRAMMING
Open Elective Course – I)

L T P C
3 0 0 3

Course Objectives:

- To understand object-oriented concepts and problem-solving techniques
- To obtain knowledge about the principles of inheritance and polymorphism
- To implement the concept of packages, interfaces, exception handling and concurrency mechanism.
- To design the GUIs using applets and swing controls.
- To understand the Java Database Connectivity Architecture

Course Outcomes:

- Solve real-world problems using OOP techniques.
- Apply code reusability through inheritance, packages and interfaces
- Solve problems using java collection framework and I/O classes.
- Develop applications by using parallel streams for better performance and develop applets for web applications.
- Build GUIs and handle events generated by user interactions and Use the JDBC API to access the database.

UNIT I Introduction

Introduction to Object Oriented Programming, The History and Evolution of Java, Introduction to Classes, Objects, Methods, Constructors, this keyword, Garbage Collection, Data Types, Variables, Type Conversion and Casting, Arrays, Operators, Control Statements, Method Overloading, Constructor Overloading, Parameter Passing, Recursion, String Class and String handling methods

UNIT II Inheritance, Packages, Interfaces

Inheritance: Basics, Using Super, Creating Multilevel hierarchy, Method overriding, Dynamic Method Dispatch, Using Abstract classes, Using final with inheritance, Object class,
Packages: Basics, Finding packages and CLASSPATH, Access Protection, Importing packages.
Interfaces: Definition, Implementing Interfaces, Extending Interfaces, Nested Interfaces, Applying Interfaces, Variables in Interfaces.

UNIT III Exception handling, Stream based I/O

Exception handling - Fundamentals, Exception types, Uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built-in exceptions, creating own exception subclasses.

Stream based I/O (java.io) – The Stream Classes-Byte streams and Character streams, Reading console Input and Writing Console Output, File class, Reading and Writing Files, Random access file operations, The Console class, Serialization, Enumerations, Autoboxing, Generics.

UNIT IV Multithreading, The Collections Framework

Multithreading: The Java thread model, creating threads, Thread priorities, Synchronizing threads, Interthread communication.

The Collections Framework (java.util): Collections overview, Collection Interfaces, The Collection classes-Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array Deque. Hashtable, Properties, Stack, Vector, String Tokenizer, Bit Set, Date, Calendar, Random, Formatter, Scanner.

UNIT V Applet, GUI Programming with Swings, Accessing Databases with JDBC

Applet: Basics, Architecture, Applet Skeleton, requesting repainting, using the status window, passing parameters to applets

GUI Programming with Swings – The origin and design philosophy of swing, components and containers,



layout managers, event handling, using a push button, jTextField, JLabel and ImageIcon, the Swing buttons, JTextField, JScrollPane, JList, JComboBox, JTree, JTable, An overview of JMenuBar, JMenu and JMenuItem, creating a main menu, show message dialog, show confirm dialog, show input dialog, show option dialog, JDialog, create a modeless dialog.

Accessing Databases with JDBC:

Types of Drivers, JDBC Architecture, JDBC classes and Interfaces, Basic steps in developing JDBC applications, Creating a new database and table with JDBC.

Textbooks:

1. Java The complete reference, 9th edition, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd.
2. Java How to Program, 10th Edition, Paul Dietel, Harvey Dietel, Pearson Education.

Reference Books:

1. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education.
2. Core Java Volume – 1 Fundamentals, Cay S. Horstmann, Pearson Education.
3. Java Programming for core and advanced learners, Sagayaraj, Dennis, Karthik and Gajalakshmi, University Press
4. Introduction to Java programming, Y. Daniel Liang, Pearson Education.
5. Object Oriented Programming through Java, P. Radha Krishna, University Press.
6. Programming in Java, S. Malhotra, S. Chaudhary, 2nd edition, Oxford Univ. Press.
7. Java Programming and Object-oriented Application Development, R.A. Johnson, Cengage Learning.

Online Learning Resources:

https://www.w3schools.com/java/java_oop.asp

<http://peterindia.net/JavaFiles.html>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-I Sem **L T P C**
3 0 0 3

(20A05505b) INTRODUCTION TO MACHINE LEARNING
Open Elective Course - I

Course Objectives:

- Understand basic concepts of Machine Learning
- Study different learning algorithms
- Illustrate evaluation of learning algorithms
- Discuss Dimensionality reduction

Course Outcomes:

- Identify machine learning techniques suitable for a given problem
- Solve the problems using various machine learning techniques
- Apply Dimensionality reduction techniques
- Design application using machine learning techniques

UNIT I Introduction to Machine Learning & Preparing to Model

Introduction: What is Human Learning? Types of Human Learning, what is Machine Learning? Types, Problems Not to Be Solved Using Machine Learning, Applications of Machine Learning, State-of-The-Art Languages/Tools in Machine Learning, Issues in Machine Learning
Preparing to Model: Introduction, Machine Learning Activities, Basic Types of Data in Machine Learning, Exploring Structure of Data, Data Quality and Remediation, Data Pre-Processing

UNIT II Modelling and Evaluation & Basics of Feature Engineering

Introduction, selecting a Model, training a Model (for Supervised Learning), Model Representation and Interpretability, Evaluating Performance of a Model, Improving Performance of a Model
Basics of Feature Engineering: Introduction, Feature Transformation, Feature Subset Selection

UNIT III Bayesian Concept Learning & Supervised Learning: Classification

Introduction, Why Bayesian Methods are Important? Bayes' Theorem, Bayes' Theorem and Concept Learning, Bayesian Belief Network
Supervised Learning: Classification: Introduction, Example of Supervised Learning, Classification Model, Classification Learning Steps, Common Classification Algorithms-k-Nearest Neighbour (kNN), Decision tree, Random Forest model, Support vector machines

UNIT IV Supervised Learning: Regression

Introduction, Example of Regression, Common Regression Algorithms-Simple linear regression, Multiple linear regression, Assumptions in Regression Analysis, Main Problems in Regression Analysis, Improving Accuracy of the Linear Regression Model, Polynomial Regression Model, Logistic Regression, Maximum Likelihood Estimation.

UNIT V Unsupervised Learning

Introduction, Unsupervised vs. Supervised Learning, Application of Unsupervised Learning, Clustering – Clustering as a machine learning task, Different types of clustering techniques, Partitioning methods, K-Medoids: a representative object-based technique, Hierarchical clustering, Density-based methods-DBSCAN, Finding Pattern using Association Rule- Definition of common terms, Association rule, the apriori algorithm for association rule learning, Build the apriori principle rules

Textbooks:

1. Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson, 2019.



Reference Books:

1. EthernAlpaydin, "Introduction to Machine Learning", MIT Press, 2004.
2. Stephen Marsland, "Machine Learning -An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
3. Andreas C. Müller and Sarah Guido "Introduction to Machine Learning with Python: A Guide for Data Scientists", Oreilly.

Online Learning Resources:

1. Andrew Ng, "Machine Learning Yearning"
2. <https://www.deeplearning.ai/machine-learning-yearning/>
3. Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press
<https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-I Sem **L T P C**
3 0 0 3
(20A12502) MOBILE APPLICATION DEVELOPMENT USING ANDROID
(Open Elective-I)

Course Objectives:

- Facilitate students to understand android SDK.
- Help students to gain a basic understanding of Android application development.
- Inculcate working knowledge of Android Studio development tool.

Course Outcomes:

- Identify various concepts of mobile programming that make it unique from programming for other platforms.
- Evaluate mobile applications on their design pros and cons.
- Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces.
- Develop mobile applications for the Android operating system that use basic and advanced phone features.
- Demonstrate the deployment of applications to the Android marketplace for distribution.

UNIT I Introduction and Mobile User Interface Design

Introduction to Android: The Android Platform, Android SDK, Android Studio Installation, Android Installation, building your First Android application, Understanding Anatomy of Android Application, Android Manifest file.

UNIT II Activities, Intents and Android User Interface

Android Application Design Essentials: Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions

UNIT III Advanced User Interface and Data Persistence

Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation.

UNIT IV Android Services, Publishing Android Applications

Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.

UNIT V Android Databases

Using Common Android APIs: Using Android Data and Storage APIs, managing data using SQLite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

Textbooks:

1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011).
2. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development," Wiley India, First Edition, 2012.

Reference Books:

1. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd
2. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd
3. Android Application Development All in one for Dummies by Barry Burd, Edition: I

Online Learning Resources:

1. <https://developer.android.com/>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-I Sem
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(20A27505) COMPUTER APPLICATIONS IN FOOD TECHNOLOGY
(Open Elective-1)

Course Objectives:

- To know different software and applications in food technology.
- To understand the Chemical kinetics in food processing, Microbial distraction in thermal processing of food.
- To acquire knowledge on computer aided manufacturing and control of food machinery, inventory control, process control.

Course Outcomes:

- Students will gain knowledge on software in food technology, data analysis, Chemical kinetics, microbial distortion in thermal process
- Use of linear regression in analyzing sensory data, application of computer in some common food industries like, milk plant, bakery units & fruits vegetable plants.

UNIT I

Introduction to various software and their applications in food technology. Application of MS Excel to solve the problems of Food Technology, SPSS and JMP for data analysis, Pro-Engineering for design, Lab VIEW and SCADA for process control .

UNIT II

Chemical kinetics in food processing: Determining rate constant of zero order reaction First order rate constant and half-life of reactions. Determining energy of activation of vitamin degradation during food storage Rates of Enzymes catalyzed reaction. Microbial distraction in thermal processing of food. Determining decimal reduction time from microbial survival data, Thermal resistance factor, Z-values in thermal processing of food. Sampling to ensure that a lot is not contaminated with more than a given percentage Statistical quality control. Probability of occurrence in normal distribution. Using binomial distribution to determine probability of occurrence. Probability of defective items in a sample obtained from large lot

UNIT III

Sensory evaluation of food Statistical descriptors of a population estimated from sensory data obtained from a sample Analysis of variance. One factor, completely randomized design For two factor design without replication. Use of linear regression in analyzing sensory data. Mechanical transport of liquid food. Measuring viscosity of liquid food using a capillary tube viscometer . Solving simultaneous equations in designing multiple effect evaporator while using matrix algebra available in excel.

UNIT IV

Familiarization with the application of computer in some common food industries like, milk plant, bakery units & fruits vegetable plants, stating from the receiving of raw material up to the storage & dispatch of finished product.

UNIT V

Basic Introduction to computer aided manufacturing. Application of computers, instrumentation and control of food machinery, inventory control, process control etc.

Recommended books:

1. Computer Applications in Food Technology: Use of Spreadsheets in Graphical, Statistical and Process Analysis by R. Paul Singh, AP.
2. Manuals of MS Office.



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-I Sem
(20A54501) OPTIMIZATION TECHNIQUES
(Open Elective- I)

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Course Objectives:

This course enables the students to classify and formulate real-life problem for modeling as optimization problem, solving and applying for decision making.

Course Outcomes: Student will be able to

- formulate a linear programming problem and solve it by various methods.
- give an optimal solution in assignment jobs, give transportation of items from sources to destinations.
- identify strategies in a game for optimal profit.
- implement project planning.

UNIT I

Introduction to operational research-Linear programming problems (LPP)-Graphical method-Simplex method-Big M Method-Dual simplex method.

UNIT II

Transportation problems- assignment problems-Game theory.

UNIT III

CPM and PERT –Network diagram-Events and activities-Project Planning-Reducing critical events and activities-Critical path calculations.

UNIT IV

Sequencing Problems-Replacement problems-Capital equipment- Discounting costs- Group replacement.

UNIT V

Inventory models-various costs- Deterministic inventory models-Economic lot size-Stochastic inventory models- Single period inventory models with shortage cost.

Textbooks:

1. Operations Research , S.D. Sharma.
2. Operations Research, An Introduction, Hamdy A. Taha, Pearson publishers.
3. Operations Research, Nita H Shah, Ravi M Gor, Hardik Soni, PHI publishers

Reference Books:

1. Problems on Operations Research, Er. Prem kumar gupta, Dr.D.S. Hira, Chand publishers
2. Operations Research, CB Gupta, PK Dwivedi, Sunil kumar yadav

Online Learning Resources:

https://nptel.ac.in/content/storage2/courses/105108127/pdf/Module_1/M1L2slides.pdf
<https://slideplayer.com/slide/7790901/>
<https://www.ime.unicamp.br/~andreani/MS515/capitulo12.pdf>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-I Sem **L T P C**
3 0 0 3
(20A56501) MATERIALS CHARACTERIZATION TECHNIQUES
(Open Elective- I)

Course Objectives:

- To provide an exposure to different characterization techniques.
- To enlighten the basic principles and analysis of different spectroscopic techniques.
- To explain the basic principle of Scanning electron microscope along with its limitations and applications.
- To identify the Resolving power and Magnification of Transmission electron microscope and its applications.
- To educate the uses of advanced electric and magnetic instruments for characterization.

Course Outcomes: At the end of the course the student will be able

- To explain the structural analysis by X-ray diffraction.
- To understand the morphology of different materials using SEM and TEM.
- To recognize basic principles of various spectroscopic techniques.
- To study the electric and magnetic properties of the materials.
- To make out which technique can be used to analyse a material

UNIT I

Structure analysis by Powder X-Ray Diffraction: Introduction, Bragg's law of diffraction, Intensity of Diffracted beams, Factors affecting Diffraction, Intensities, Structure of polycrystalline Aggregates, Determination of crystal structure, Crystallite size by Scherrer and Williamson-Hall (W-H) Methods, Small angle X-ray scattering (SAXS) (in brief).

UNIT II

Microscopy technique -1 –Scanning Electron Microscopy (SEM)

Introduction, Principle, Construction and working principle of Scanning Electron Microscopy, Specimen preparation, Different types of modes used (Secondary Electron and Backscatter Electron), Advantages, limitations and applications of SEM.

UNIT III

Microscopy Technique -2 - Transmission Electron Microscopy (TEM): Construction and Working principle, Resolving power and Magnification, Bright and dark fields, Diffraction and image formation, Specimen preparation, Selected Area Diffraction, Applications of Transmission Electron Microscopy, Difference between SEM and TEM, Advantage and Limitations of Transmission Electron Microscopy.

UNIT IV

Spectroscopy techniques – Principle, Experimental arrangement, Analysis and advantages of the spectroscopic techniques – (i) UV-Visible spectroscopy (ii) Raman Spectroscopy, (iii) Fourier Transform infrared (FTIR) spectroscopy, (iv) X-ray photoelectron spectroscopy (XPS).

UNIT V

Electrical & Magnetic Characterization techniques: Electrical Properties analysis techniques (DC conductivity, AC conductivity) Activation Energy, Effect of Magnetic field on the electrical properties (Hall Effect). Magnetization measurement by induction method, Vibrating sample Magnetometer (VSM) and SQUID.

Textbooks:

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods –Yang Leng – John Wiley & Sons (Asia) Pvt. Ltd. 2008
2. Handbook of Materials Characterization -by Sharma S. K. - Springer

References:

1. Fundamentals of Molecular Spectroscopy – IV Ed. – Colin Neville Banwell and Elaine M. McCash, Tata McGraw-Hill, 2008.
2. Elements of X-ray diffraction – Bernard Dennis Cullity & Stuart R Stocks, Prentice Hall, 2001
3. Materials Characterization: Introduction to Microscopic and Spectroscopic Methods-[Yang Leng](#)- John Wiley & Sons
4. Characterization of Materials 2nd Edition, 3 Volumes-Kaufmann E N -John Wiley (Bp)



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-I Sem **L T P C**
3 0 0 3
(20A51501) CHEMISTRY OF ENERGY MATERIALS
(Open Elective- I)

Course Objectives:

- To make the student understand basic electrochemical principles such as standard electrode potentials, emf and applications of electrochemical principles in the design of batteries.
- To understand the basic concepts of processing and limitations of fossil fuels and Fuel cells & their applications.
- To impart knowledge to the students about fundamental concepts of hydrogen storage in different materials and liquification method
- Necessasity of harnessing alternate energy resources such as solar energy and its basic concepts.
- To understand and apply the basics of calculations related to material and energy flow in the processes.

Course Outcomes:

- Ability to perform simultaneous material and energy balances.
- Student learn about various electrochemical and energy systems
- Knowledge of solid, liquid and gaseous fuels
- To know the energy demand of world, nation and available resources to fulfill the demand
- To know about the conventional energy resources and their effective utilization
- To acquire the knowledge of modern energy conversion technologies
- To be able to understand and perform the various characterization techniques of fuels
- To be able to identify available nonconventional (renewable) energy resources and techniques to utilize them effectively

UNIT I: Electrochemical Systems: Galvanic cell, standard electrode potential, application of EMF, electrical double layer, dipole moments, polarization, Batteries-Lead-acid and Lithium ion batteries.

UNIT II: Fuel Cells: Fuel cell working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Fuel cell efficiency, Basic design of fuel cell,.

UNIT III: Hydrogen Storage: Hydrogen Storage, Chemical and Physical methods of hydrogen storage, Hydrogen Storage in metal hydrides, metal organic frame works (MOF), Carbon structures, metal oxide porous structures, hydrogel storage by high pressure methods. Liquifaction method.

UNIT IV: Solar Energy: Solar energy introduction and prospects, photo voltaic (PV) technology, concentrated solar power (CSP), Solar Fuels, Solar cells.

UNIT V: Photo and Photo electrochemical Conversions: Photochemical cells and applications of photochemical reactions, specificity of photo electrochemical cell, advantage of photoelectron catalytic conversions.

References:

1. Physical chemistry by Ira N. Levine
2. Essentials of Physical Chemistry, Bahl and Bahl and Tuli.
3. Inorganic Chemistry, Silver and Atkins
4. Fuel Cell Hand Book 7th Edition, by US Department of Energy (EG&G technical services and corporation)
5. Hand book of solar energy and applications by Arvind Tiwari and Shyam.
6. Solar energy fundamental, technology and systems by Klaus Jagar et.al.
7. Hydrogen storage by Levine Klebonoff



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-I Sem

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(20A52501) ACADEMIC WRITING AND PUBLIC SPEAKING
(Open Elective-I)

Course Objectives:

- To encourage all round development of the students by focusing on soft skills
- To make the students aware of critical thinking skills and problem-solving skills
- To develop leadership skills and organizational skills through group activities
- To function effectively with heterogeneous teams

Course Outcomes:

- Memorize various elements of Academic Writing
- Understand how to paraphrase sources and avoid plagiarism
- Demonstrate the knowledge in writing a Research paper
- Analyse different types of essays
- Judge the speeches of others and know the positive strengths of speakers
- Build confidence in giving an impactful presentation to the audience

UNIT I Introduction to Academic Writing

Introduction to Academic Writing – Essential Features of Academic Writing – Courtesy – Clarity – Conciseness – Correctness – Coherence– Completeness – Types – Descriptive, Analytical, Persuasive, Critical writing

Academic Journal Article

UNIT II

Art of condensation- summarizing and paraphrasing - Abstract Writing, Technical/Research/Journal Paper Writing – Conference Paper writing - Editing, Proof Reading - Plagiarism

UNIT III Essay & Book Report

Compare and Contrast – Argumentative Essay – Exploratory Essay – Features and Analysis of Sample Essays – Writing Book Report, Summarizing, Book Review-

UNIT IV Public Speaking

Introduction, Nature, characteristics, significance of Public Speaking – Presentation – 4 Ps of presentation – Stage Dynamics – Answering Strategies –Analysis of Impactful Speeches- Speeches for Academic events

UNIT V Public Speaking and Non-Verbal Delivery

Body Language – Kinesics – Oculistics – Proxemics – Haptics – Paralanguage

Textbooks:

1. Critical Thinking, Academic Writing and Presentation Skills: Mg University Edition Paperback – 1 January 2010 Pearson Education; First edition (1 January 2010)
2. A Course In Academic Writing Paperback – 1 January 2017Publisher : The Orient Blackswan; second edition (1 January 2017)

Reference Books:

1. A Handbook For Academic Writing and Composition Paperback – 1 January 2014 by [Nzanmongi Jasmine Patton](#) Publisher : Pinnacle Learning; 1st edition (1 January 2014)
2. Critical Thinking, Academic Writing and Presentation Skills: Mg University Edition Paperback – 1 January 2010Publisher : Pearson Education; First edition (1 January 2010) by [Marilyn Anderson](#) (Author)
3. Effective Academic Writing Second Edition: 1: Student Book: The Paragraph Paperback – Student Edition, 9 June 2014by [Alice Savage](#) (Author), [Masoud Shafiei](#) (Author)Publisher : Oxford University Press; Student, Workbook edition (9 June 2014)



4. A Course In Academic Writing Paperback – 1 January 2017 by [Renu Gupta](#) (Author) Publisher : The Orient Blackswan; Second edition (1 January 2017)

Online Learning Resources:

1. <https://youtu.be/NNhTIT81nH8>
2. <https://www.youtube.com/watch?v=478ccrWKY-A>
3. <https://www.youtube.com/watch?v=nzGo5ZC1gMw>
4. <https://www.youtube.com/watch?v=Qve0ZBmJMh4>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR				
B.Tech IV-I Sem	L	T	P	C
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(20A01704) ENVIRONMENTAL ECONOMICS
(Open Elective Course - II)

Course Objectives:

- To impart knowledge on sustainable development and economics of energy
- To teach regarding environmental degradation and economic analysis of degradation
- To inculcate the knowledge of economics of pollution and their management
- To demonstrate the understanding of cost benefit analysis of environmental resources
- To make the students to understand principles of economics of biodiversity

Course Outcomes :

- The information on sustainable development and economics of energy
- The information regarding environmental degradation and economic analysis of degradation
- The identification of economics of pollution and their management
- The cost benefit analysis of environmental resources
- The principles of economics of biodiversity

UNIT I

Sustainable Development: Introduction to sustainable development - Economy-Environment inter-linkages - Meaning of sustainable development - Limits to growth and the environmental Kuznets curve – The sustainability debate - Issues of energy and the economics of energy – Nonrenewable energy, scarcity, optimal resources, backstop technology, property research, externalities, and the conversion of uncertainty.

UNIT II

Environmental Degradation: Economic significance and causes of environmental degradation - The concepts of policy failure, externality and market failure - Economic analysis of environmental degradation – Equi –marginal principle.

UNIT - III

Economics of Pollution: Economics of Pollution - Economics of optimal pollution, regulation, monitoring and enforcement - Managing pollution using existing markets: Bargaining solutions – Managing pollution through market intervention: Taxes, subsidies and permits.

UNIT IV

Cost – Benefit Analysis: Economic value of environmental resources and environmental damage - Concept of Total Economic Value - Alternative approaches to valuation – Cost-benefit analysis and discounting.

UNIT V

Economics of biodiversity: Economics of biodiversity conservation - Valuing individual species and diversity of species -Policy responses at national and international levels. Economics of Climate Change – stern Report

Textbooks:

1. An Introduction to Environmental Economics by N. Hanley, J. Shogren and B. White Oxford University Press.(2001)
2. Blueprint for a Green Economy by D.W. Pearce, A. Markandya and E.B. Barbier Earthscan, London.(1989)

Reference Books:

1. Environmental Economics: An Elementary Introduction by R.K. Turner, D.W. Pearce and I. Bateman Harvester Wheatsheaf, London. (1994),
2. Economics of Natural Resources and the Environment by D.W. Pearce and R.K. Turner Harvester Wheat sheaf, London. (1990),
3. Environmental and Resource Economics: An Introduction by Michael S. Common and Michael Stuart 2nd Edition, Harlow: Longman.(1996),
4. Natural Resource and Environmental Economics by Roger Perman, Michael Common, Yue Ma and James Mc Gilvray 3rd Edition, Pearson Education.(2003),



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-II Sem **L T P C**
3 0 0 3

(20A02605) SMART ELECTRIC GRID
(Open Elective Course-II)

Course Objectives:

- Understand recent trends in grids, smart grid architecture and technologies
- Analyze smart substations
- Apply the concepts to design smart transmission systems
- Apply the concepts to design smart distribution systems

Course Outcomes:

- Understand trends in Smart grids, needs and roles of Smart substations
- Design and Analyze Smart Transmission systems
- Design and Analyze Smart Distribution systems
- Analyze SCADA and DSCADA systems in practical working environment

UNIT I INTRODUCTION TO SMART GRID

Working definitions of Smart Grid and Associated Concepts – Smart Grid Functions – Traditional Power Grid and Smart Grid – New Technologies for Smart Grid – Advantages – Indian Smart Grid – Key Challenges for Smart Grid

UNIT II SMART GRID TECHNOLOGIES

Characteristics of Smart grid, Micro grids, Definitions, Drives, benefits, types of Micro grid, building blocks, Renewable energy resources, needs in smart grid, integration impact, integration standards, Load frequency control, reactive power control, case studies and test beds

UNIT III SMART SUBSTATIONS

Protection, Monitoring and control devices, sensors, SCADA, Master stations, Remote terminal unit, interoperability and IEC 61850, Process level, Bay level, Station level, Benefits, role of substations in smart grid, Volt/VAR control equipment inside substation

UNIT IV SMART TRANSMISSION SYSTEMS

Energy Management systems, History, current technology, EMS for the smart grid, Synchro Phasor Measurement Units (PMUs), Wide Area Monitoring Systems (WAMS), protection & Control (WAMPC), needs in smart grid, Role of WAMPC smart grid, Drivers and benefits, Role of transmission systems in smart grid

UNIT V SMART DISTRIBUTION SYSTEMS

DMS, DSCADA, trends in DSCADA and control, current and advanced DMSs, Voltage fluctuations, effect of voltage on customer load, Drivers, objectives and benefits, voltage-VAR control, VAR control equipment on distribution feeders, implementation and optimization, FDIR - Fault Detection Isolation and Service restoration (FDIR), faults, objectives and benefits, equipment, implementation

Textbooks:

1. Stuart Borlase, Smart Grids - Infrastructure, Technology and Solutions, CRC Press, 1e, 2013
2. Gil Masters, Renewable and Efficient Electric Power System, Wiley–IEEE Press, 2e, 2013.

Reference Books:

1. A.G. Phadke and J.S. Thorp, Synchronized Phasor Measurements and their Applications, Springer Edition, 2e, 2017.
2. T. Ackermann, Wind Power in Power Systems, Hoboken, NJ, USA, John Wiley, 2e, 2012.

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ee82/preview



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem

L T P C
3 0 0 3

(20A04704) SIGNAL PROCESSING
(Open Elective Course –II)

Course objectives:

- Understand, represent and classify continuous time and discrete time signals and systems, together with the representation of LTI systems.
- Ability to represent continuous time signals (both periodic and non-periodic) in the time domain, sdomain and the frequency domain
- Understand the properties of analog filters, and have the ability to design Butterworth filters
- Understand and apply sampling theorem and convert a signal from continuous time to discrete time or from discrete time to continuous time (without loss of information)
- Able to represent the discrete time signal in the frequency domain
- Able to design FIR and IIR filters to meet given specifications

Course Outcomes:

- Understand and explain continuous time and discrete time signals and systems, in time and frequency domain
- Apply the concepts of signals and systems to obtain the desired parameter/ representation
- Analyse the given system and classify the system/arrive at a suitable conclusion
- Design analog/digital filters to meet given specifications
- Design and implement the analog filter using components/ suitable simulation tools
- Design and implement the digital filter using suitable simulation tools, and record the input and output of the filter for the given audio signal

UNIT I

Signal Definition, Signal Classification, System definition, System classification, for both continuous time and discrete time. Definition of LTI systems

UNIT II

Introduction to Fourier Transform, Fourier Series, Relating the Laplace Transform to Fourier Transform, Frequency response of continuous time systems

UNIT III

Frequency response of ideal analog filters, Salient features of Butterworth filters Design and implementation of Analog Butterworth filters to meet given specifications

UNIT IV

Sampling Theorem- Statement and proof, converting the analog signal to a digital signal. Practical sampling. The Discrete Fourier Transform, Properties of DFT. Comparing the frequency response of analog and digital systems.

UNIT V

Definition of FIR and IIR filters. Frequency response of ideal digital filters
Transforming the Analog Butterworth filter to the Digital IIR Filter using suitable mapping techniques, to meet given specifications. Design of FIR Filters using the Window technique, and the frequency sampling technique to meet given specifications Comparing the designed filter with the desired filter frequency response

Textbooks:

1. 'Signals and Systems', by Simon Haykin and Barry Van Veen, Wiley.

References:

1. 'Theory and Application of Digital Signal Processing', Rabiner and Gold
2. 'Signals and Systems', Schaum's Outline series
3. 'Digital Signal Processing', Schaum's Outline series



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-II Sem
(20A05605a) PRINCIPLES OF OPERATING SYSTEMS
(Open Elective Course – II)

L T P C
3 0 0 3

Course Objectives:

- Understand basic concepts and functions of operating systems
- Understand the processes, threads and scheduling algorithms.
- Expose the students with different techniques of handling deadlocks
- Provide good insight on various memory management techniques
- Explore the concept of file-system and its implementation issues

Course Outcomes:

- Demonstrate and understand of computer systems and operating systems functions
- Distinguish between process and thread and classify scheduling algorithms
- Solve synchronization and deadlock problems
- Compare various memory management schemes
- Explain file systems concepts and i/o management

UNIT I Introduction to Computer and Operating system

Computer Types, Functional Units, Basic Operational Concepts, Number Representation and Arithmetic Operations, Character Representation, Performance, Historical Perspective, Memory Locations and Addresses, Memory operations, Instructions and Instruction Sequencing, Addressing modes
Architecture Operating System Structure, Operations Process, Memory, Storage Management, Protection and Security Computing Environments Operating System Services User Operating System Interface System Calls Types System Programs OS Structure OS Generation System Boot.

UNIT II Process, Threads and Scheduling

Process Concept Scheduling Operations on Processes Cooperating Processes Inter-Process Communication Threads - Multithreading Models -Thread Libraries- Threading Issues – Scheduling Criteria Scheduling Algorithms Algorithm Evaluation.

UNIT III Process Synchronization and Deadlocks

The Critical-Section Problem Synchronization Hardware Mutex Locks -Semaphores Classic Problems of Synchronization Critical Regions Monitors Deadlocks System Model Deadlock Characterization Methods for Handling Deadlocks Deadlock Prevention Deadlock Avoidance Deadlock Detection Recovery from Deadlock.

UNIT IV Memory Management

Introduction - Swapping Contiguous Memory Allocation Paging Segmentation- Structure of the Page Table - Virtual Memory- Background Demand Paging Copy on Write Page Replacement Allocation of Frames Thrashing.

UNIT V Input/ Output and Files

Overview of Mass Storage Structure - Disk Structure - Disk Scheduling and Management-File System Interface File Concept - Access Methods -Directory and Disk Structure- Directory Implementation - Allocation Methods- I/O Systems I/O Hardware- Application I/O Interface - Kernel I/O Subsystem.

Textbooks:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.
2. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating Systems Concepts, Ninth Edition, Wiley, 2012.

Reference Books:

1. William Stallings, Operating Systems: Internals and Design Principles, Ninth Edition, Prentice-Hall, 2018.
2. Andrew Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall, 2009.



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-II Sem **L T P C**
3 0 0 3

(20A05605b) ARTIFICIAL INTELLIGENCE
Open Elective Course– II

Course Objectives:

- To introduce Artificial Intelligence
- To Teach about the machine learning environment
- To Present the searching Technique for Problem Solving
- To Introduce Natural Language Processing and Robotics

Course Outcomes:

- Apply searching techniques for solving a problem
- Design Intelligent Agents
- Develop Natural Language Interface for Machines
- Design mini robots
- Summarize past, present and future of Artificial Intelligence

UNIT I Introduction

Introduction: What is AI, Foundations of AI, History of AI, The State of Art.

Intelligent Agents: Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

UNIT II Solving Problems by searching

Problem Solving Agents, Example problems, Searching for Solutions, Uninformed Search Strategies, Informed search strategies, Heuristic Functions, Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with partial observations, online search agents and unknown environments.

UNIT III Reinforcement Learning & Natural Language Processing

Reinforcement Learning: Introduction, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Policy Search, applications of RL

Natural Language Processing: Language Models, Text Classification, Information Retrieval, Information Extraction.

UNIT IV Natural Language for Communication

Natural Language for Communication: Phrase structure grammars, Syntactic Analysis, Augmented Grammars and semantic Interpretation, Machine Translation, Speech Recognition

Perception: Image Formation, Early Image Processing Operations, Object Recognition by appearance, Reconstructing the 3D World, Object Recognition from Structural information, Using Vision.

UNIT V Robotics

Robotics: Introduction, Robot Hardware, Robotic Perception, planning to move, planning uncertain movements, Moving, Robotic software architectures, application domains

Philosophical foundations: Weak AI, Strong AI, Ethics and Risks of AI, Agent Components, Agent Architectures, are we going in the right direction, what if AI does succeed.

Textbooks:

1. Stuart J. Russell, Peter Norvig, "Artificial Intelligence A Modern Approach", 3rd Edition, Pearson Education, 2019.

References:

1. Nilsson, Nils J., and Nils Johan Nilsson. Artificial intelligence: a new synthesis. Morgan Kaufmann, 1998.
2. Johnson, Benny G., Fred Phillips, and Linda G. Chase. "An intelligent tutoring system for the accounting cycle: Enhancing textbook homework with artificial intelligence." Journal of Accounting Education 27.1 (2009): 30-39.

Online Learning Resources:

1. <http://peterindia.net/AILinks.html>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-II Sem **L T P C**
3 0 0 3

(20A04701b) INTRODUCTION TO INTERNET OF THINGS
(Open Elective Course-II)

Course Objectives:

Students will understand the concepts of Internet of Things and can able to build IoT applications.

Course Outcomes:

- Understand the concepts of Internet of Things
- Identify hardware and software components of Internet of Things
- Analyze basic communication protocols
- Design IoT applications in different domain and be able to analyze their performance

UNIT 1

Introduction to IoT: Architectural overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals-Devices and gateways, Data management, Business processes in IoT, Role of cloud in IoT

UNIT II

Elements of IoT: Hardware components – computing (Arduino, Raspberry Pi), communication, Sensing, Actuation, I/O interfaces Software Components- Programming APIs (Using python/Arduino) for communication protocols-MQTT, Zigbee, Bluetooth, CoAP, UDP, TCP

UNIT III

Sensing and Actuation: Definition of Sensor, Sensor features, Resolution, Classes, Different types of sensors, Actuator, Different types of Actuators, purpose of Sensors and Actuators in IoT

UNIT IV

IoT Application Development: Solution frame work for IoT Applications-Implementation of Device integration, Data acquisition and Integration, Device data storage on cloud/local server, Authentication, authorization of Devices

UNIT V

IoT Case Studies: IoT Case studies and mini projects based on industrial Automation, Transportation, Agriculture, Healthcare, Home Automation.

Textbooks:

1. Vijay Madiseti, ArshdeepBahga, “Internet of Things a Hands-On- Approach”,2014.

References:

1. Dr SRN Reddy, Rachit Thukral and Manasi Mishra ,” Introduction to Internet of Things”: A practical Approach” ETI Labs
2. Raj Kamal , “ Internet of Things: Architecture and Design”, McGraw Hill
3. Adrian McEwen, “Designing the Internet of Things”, Wiley Publishers, 2013



JAWAHARLAL NERU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (IT)– III-II Sem

	L T P C
	3 0 0 3

(20A12603) DATA ANALYTICS USING R
(Open Elective-II)

Course Objectives:

- Facilitate students to understand R programming
- Help students to gain a basic understanding of Data Analytics
- Inculcate working knowledge of plotting

Course Outcomes:

- Identify and execute basic syntax and programs in R
- Perform the Matrix operations using R built in functions
- Apply nonnumeric values in vectors
- Create the list and data frames
- Exploit the graph using ggplot2.

UNIT I Introduction to R Programming

History and Overview of R- Basic Features of R-Design of the R System- Installation of R- Console and Editor Panes- Comments- Installing and Loading R Packages- Help Files and Function Documentation-Saving Work and Exiting R- Conventions- R for Basic Math- Arithmetic- Logarithms and Exponentials - E-Notation - Assigning Objects – Vectors - Creating a Vector-Sequences, Repetition, Sorting and Lengths – Subsetting and Element Extraction -Vector – Oriented Behavior.

UNIT II Matrices and Arrays

Defining a Matrix – Defining a Matrix- Filling Direction- Row and Column Bindings- Matrix Dimensions-Subsetting- Row, Column, and Diagonal Extractions- Omitting and Overwriting- Matrix Operations and Algebra- Matrix Transpose- Identity Matrix- Matrix Addition and Subtraction- Matrix Multiplication-Matrix Inversion-Multidimensional Arrays-Subsets, Extractions and Replacements.

UNIT III Non-Numeric values

Logical Values- Relational Operators- Characters- Creating a String- Concatenation- Escape Sequences-Substrings and Matching- Factors- Identifying Categories- Defining and Ordering Levels- Combining and Cutting.

UNIT IV Lists and Data frames

List of Objects - Component Access – Naming – Nesting - Data Frames - Adding Data Columns and Combining Data Frames – Logical Record Subsets – Some Special Values – Infinity – NaN – NA - NULL – Attributes – Object - Class-Is-Dot Object-Checking Functions-As-Dot Coercion Functions

UNIT V Basic Plotting

Using plot with Coordinate Vectors-Graphical Parameters-Automatic Plot Types-Title and Axis Labels-Color-Line and Point Appearances-Plotting Region Limits-Adding Points, Lines, and Text to an ExistingPlot-ggplot2 Package-Quick Plot with qplot-Setting Appearance Constants with Geoms— Reading and Writing Files- R-Ready Data Sets- Contributed Data Sets- Reading in External Data Files- Writing Out Data Files and Plots-AdHoc Object Read/Write Operations

Textbooks:

1. Tilman M. Davies, “The Book of R-A First Programming, Statistics” Library of Congress Cataloging-in-Publication Data, 2016.

Reference Books:

1. Hadley Wickham, Garrett Grolemund, ”R for Data Science”, Oreilly Publication, 2017.
2. Roger D. Peng, “R Programming for Data Science” Lean Publishing, 2016.
3. Steven Keller, “R Programming for Beginners”, CreateSpace Independent Publishing Platform 2016.

Online Learning Resources:

1. <https://www.coursera.org/learn/data-analysis-r>
2. <https://www.careers360.com/courses-certifications/data-analysis-with-r-courses-brpg>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-II Sem

L	T	P	C
3	0	0	3

(20A27605) FOOD REFRIGERATION AND COLD CHAIN MANAGEMENT
OPEN ELECTIVE II

Course Objectives:

- To know the equipment available to store perishable items for a long time
- To understand to increase the storage life of food items

Course Outcomes

By the end of the course, the students will

- Understand various principles and theories involved in refrigeration systems
- Understand the different equipment useful to store the food items for a long period.
- Understand how to increase the storage life of food items

UNIT I

Principles of refrigeration: Definition, background with second law of thermodynamics, unit of refrigerating capacity, coefficient of performance; Production of low temperatures: Expansion of a liquid with flashing, reversible/ irreversible adiabatic expansion of a gas/ real gas, thermoelectric cooling, adiabatic demagnetization; Air refrigerators working on reverse Carnot cycle: Carnot cycle, reversed Carnot cycle, selection of operating temperatures;

UNIT II

Air refrigerators working on Bell Coleman cycle: Reversed Brayton or Joule or Bell Coleman cycle, analysis of gas cycle, polytropic and multistage compression; Vapour refrigeration: Vapor as a refrigerant in reversed Carnot cycle with p-V and T-s diagrams, limitations of reversed Carnot cycle; Vapour compression system: Modifications in reverse Carnot cycle with vapour as a refrigerant (dry vs wet compression, throttling vs isentropic expansion), representation of vapor compression cycle on pressure- enthalpy diagram, super heating, sub cooling;

UNIT III

Liquid-vapour regenerative heat exchanger for vapour compression system, effect of suction vapour super heat and liquid sub cooling, actual vapour compression cycle; Vapour-absorption refrigeration system: Process, calculations, maximum coefficient of performance of a heat operated refrigerating machine, Common refrigerants and their properties: classification, nomenclature, desirable properties of refrigerants- physical, chemical, safety, thermodynamic and economical; Azeotropes; Components of vapour compression refrigeration system, evaporator, compressor, condenser and expansion valve;

UNIT IV

Ice manufacture, principles and systems of ice production, Treatment of water for making ice, brines, freezing tanks, ice cans, air agitation, quality of ice; Cold storage: Cold store, design of cold storage for different categories of food resources, size and shape, construction and material, insulation, vapour barriers, floors, frost-heave, interior finish and fitting, evaporators, automated cold stores, security of operations; Refrigerated transport: Handling and distribution, cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display;

UNIT V

Air-conditioning: Meaning, factors affecting comfort air-conditioning, classification, sensible heat factor, industrial air-conditioning, problems on sensible heat factor; Winter/summer/year round air-conditioning, unitary air-conditioning systems, central air-conditioning, physiological principles in air-conditioning, air distribution and duct design methods; design of complete air-conditioning systems; humidifiers and dehumidifiers; Cooling load calculations: Load sources, product cooling, conducted heat, convected heat, internal heat sources, heat of respiration, peak load; etc.



Textbooks:

1. Arora, C. P. “Refrigeration and Air Conditioning”. Tata MC Graw Hill Publishing Co.Ltd., New Delhi. 1993.

References:

1. Adithan, M. and Laroia, S. C. “Practical Refrigeration and Air Conditioning”. Wiley Eastern Ltd., New Delhi 1991



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-II Sem

L T P C
3 0 0 3

(20A54701) WAVELET TRANSFORMS AND ITS APPLICATIONS
(Open Elective-II)

Course Objectives:

This course provides the students to understand Wavelet transforms and its applications.

Course Outcomes:

- Understand wavelets and wavelet expansion systems.
- Illustrate the multi resolution analysis and scaling functions.
- Form fine scale to coarse scale analysis.
- Find the lattices and lifting.
- Perform numerical complexity of discrete wavelet transforms.
- Find the frames and tight frames using fourier series.

UNIT I Wavelets

Wavelets and Wavelet Expansion Systems - Wavelet Expansion- Wavelet Transform- Wavelet System- More Specific Characteristics of Wavelet Systems -Haar Scaling Functions and Wavelets - effectiveness of Wavelet Analysis -The Discrete Wavelet Transform the Discrete-Time and Continuous Wavelet Transforms.

UNIT II A Multiresolution Formulation of Wavelet Systems

Signal Spaces -The Scaling Function -Multiresolution Analysis - The Wavelet Functions - The Discrete Wavelet Transform- A Parseval's Theorem - Display of the Discrete Wavelet Transform and the Wavelet Expansion.

UNIT III Filter Banks and the Discrete Wavelet Transform

Analysis - From Fine Scale to Coarse Scale- Filtering and Down-Sampling or Decimating -Synthesis - From Coarse Scale to Fine Scale -Filtering and Up-Sampling or Stretching - Input Coefficients - Lattices and Lifting - -Different Points of View.

UNIT IV Time-Frequency and Complexity

Multiresolution versus Time-Frequency Analysis- Periodic versus Nonperiodic Discrete Wavelet Transforms -The Discrete Wavelet Transform versus the Discrete-Time Wavelet Transform- Numerical Complexity of the Discrete Wavelet Transform.

UNIT V Bases and Matrix Examples

Bases, Orthogonal Bases, and Biorthogonal Bases -Matrix Examples - Fourier Series Example - Sine Expansion Example - Frames and Tight Frames - Matrix Examples -Sine Expansion as a Tight Frame Example.

Textbooks:

1. C. Sidney Burrus, Ramesh A. Gopinath, "Introduction to Wavelets and Wavelets Transforms", Prentice Hall, (1997).
2. James S. Walker, "A Primer on Wavelets and their Scientific Applications", CRC Press, (1999).

Reference Books:

1. Raghuvver Rao, "Wavelet Transforms", Pearson Education, Asia.

Online Learning Resources:

<https://www.slideshare.net/RajEndiran1/introduction-to-wavelet-transform-51504915>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-II Sem **L T P C**
3 0 0 3
(20A56701) PHYSICS OF ELECTRONIC MATERIALS AND DEVICES
(Open Elective-II)

Course Objectives:

- To impart the fundamental knowledge on various materials, their properties and applications.
- To provide insight into various semiconducting materials, and their properties.
- To enlighten the characteristic behavior of various semiconductor devices.
- To provide the basics of dielectric and piezoelectric materials and their properties.
- To explain different categories of magnetic materials, mechanism and their advanced applications.

Course Outcome: At the end of the course the student will be able

- To understand the fundamentals of various materials.
- To exploit the physics of semiconducting materials
- To familiarize with the working principles of semiconductor-based devices.
- To understand the behaviour of dielectric and piezoelectric materials.
- To identify the magnetic materials and their advanced applications.

UNIT I Fundamentals of Materials Science

Introduction, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. Basic idea of point, line and planar defects. Concept of thin films, preparation of thin films, Deposition of thin film using sputtering methods (RT and glow discharge).

UNIT II Semiconductors

Introduction, charge carriers in semiconductors, effective mass, Diffusion and drift, Diffusion and recombination, Diffusion length. The Fermi level & Fermi-Dirac distribution, Electron and Hole in quantum well, Change of electron-hole concentration- Qualitative analysis, Temperature dependency of carrier concentration, Conductivity and mobility, Effects of temperature and doping on mobility, High field effects.

UNIT III Physics of Semiconductor devices

Introduction, Band structure, PN junctions and their typical characteristics under equilibrium and under bias, Construction and working principles of: Light emitting diodes, Heterojunctions, Transistors, FET and MOSFETs.

UNIT IV Dielectric Materials and their applications:

Introduction, Dielectric properties, Electronic polarizability and susceptibility, Dielectric constant and frequency dependence of polarization, Dielectric strength and dielectric loss, Piezoelectric properties.

UNIT V Magnetic Materials and their applications

Introduction, Magnetism & various contributions to para and dia magnetism, Ferro and Ferri magnetism and ferrites, Concepts of Spin waves and Magnons, Anti-ferromagnetism, Domains and domain walls, Coercive force, Hysteresis, Nano-magnetism, Super-paramagnetism – Properties and applications.

Textbooks

1. Principles of Electronic Materials and Devices- S.O. Kasap, McGraw-Hill Education (India) Pvt. Ltd., 3rd edition, 2007.
2. Electronic Components and Materials- Grover and Jamwal, Dhanpat Rai and Co.

Reference Books:

1. Solid State Electronic Devices -B.G. Streetman and S. Banerjee, PHI Learning, 6th edition
2. Electronic Materials Science- Eugene A. Irene, Wiley, 2005
3. An Introduction to Electronic Materials for Engineers-Wei Gao, Zhengwei Li, Nigel Sammes, World Scientific Publishing Co. Pvt. Ltd., 2nd Edition, 2011
4. A First Course In Material Science- by Raghvan, McGraw Hill Pub.
5. The Science and Engineering of materials- Donald R. Askeland, Chapman & Hall Pub.

NPTEL courses links: <https://nptel.ac.in/courses/113/106/113106062/>,
https://onlinecourses.nptel.ac.in/noc20_mm02/preview,
<https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-mm07>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech III-II Sem
(20A52702) ENGLISH LITERARY SPECTRUM
(Open Elective-II)

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Course Objectives:

- To introduce to Elizabethan drama and be able to appreciate the nuances of humor
- To familiarize with Victorian novel and industrialization
- To expose to the historical significance of ideas of different periods
- To give exposure to the vicissitudes of life through short stories to encourage all round development of the students by focusing on soft skills

Course Outcomes:

- Define various concepts related to British literature
- Understand humour and Elizabethan culture
- Demonstrate proficiency in oral communication through drama
- Analyse texts from a variety of theatrical perspectives and be tolerant and receptive to different ideas
- Appraise human values and aspirations
- Create written texts in a variety of literary genres and develop aesthetic sense to appreciate the beauty of life

UNIT I **Poetry**

1. Ode to a Grecian Urn- John Keats
2. To a Skylark- P.B.Shelley
3. Satan's Speech from Paradise Lost Book I- 140-170 lines- John Milton
4. My Last Duchess- Robert Browning

UNIT II **Drama**

1. Twelfth Night- William Shakespeare
 - a) Elizabethan theatre
 - b) Shakespearean tragedy
 - c) Shakespearean Comedy
 - d) Themes of Shakespearean Dramas

UNIT III **Novel**

1. Hard Times- Charles Dickens
 - a) Rise of the English Novel
 - b) Victorian Novel
 - c) Utilitarianism
 - d) Humanism

UNIT IV **Prose**

1. Of Studies – Francis Bacon
2. On Seeing People Off- A.G.Gardiner
3. Sweetness and Light- Mathew Arnold
4. I too have a Dream- Martin Luther King Junior

UNIT V **Short stories**

1. The Last Leaf- O.Henry
2. Useless Beauty- Guy de Maupassant
3. After the Dance – Leo Tolstoy
4. The Selfish Giant- Oscar Wilde



Textbooks:

1. The Oxford Book of English Verse by [Christopher Ricks](#) (Editor)
2. Twelfth Night (2010 edition): Oxford School Shakespeare (Oxford School Shakespeare Series)
Hard Times (Penguin Classics)

Reference Books:

1. The Art of the Personal Essay: An Anthology from the Classical Era to the Present, Anchor Books Publication
2. Legois and Cazamian, A History of English Literature

Online Learning Resources:

[Study.com](#)

[What Is Twelfth Night About? - Plot & Summary - Video & Lesson Transcript | Study.com](#)



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem

L T P C
3 0 0 3

(20A01705) COST EFFECTIVE HOUSING TECHNIQUES
(Open Elective Course - III)

Course Objectives:

- To understand the requirements of structural safety for future construction.
- To know about the housing scenario, housing financial systems land use and physical planning for housing and housing the urban poor
- To know the traditional practices of rural housing
- To know the different innovative cost effective construction techniques
- To know the alternative building materials for low cost housing.

Course Outcomes :

- To know the repair and restore action of earthquake damaged non engineered buildings and ability to understand the requirements of structural safety for future construction
- To know about the housing scenario, housing financial systems land use and physical planning for housing and housing the urban poor
- Apply the traditional practices of rural housing
- Understand the different innovative cost effective construction techniques
- Suggest the alternative building materials for low cost housing

UNIT I

- Housing Scenario** :Introducing - Status of urban housing - Status of Rural Housing
- Housing Finance**: Introducing - Existing finance system in India - Government role as facilitator - Status at Rural Housing Finance - Impedimently in housing finance and related issues
- Land use and physical planning for housing** :Introduction - Planning of urban land - Urban land ceiling and regulation act - Efficiency of building bye lass - Residential Densities
- Housing the urban poor** :Introduction - Living conditions in slums - Approaches and strategies for housing urban poor

UNIT II

Development and adoption of low cost housing technology

Introduction - Adoption of innovative cost effective construction techniques - Adoption of precast elements in partial prefabrication - Adopting of total prefabrication of mass housing in India- General remarks on pre cast roofing/flooring systems -Economical wall system - Single Brick thick load bearing wall - 19cm thick load bearing masonry walls - Half brick thick load bearing wall – Fly-ash gypsum thick for masonry - Stone Block masonry - Adoption of precast R.C. plank and joint system for roof/floor in the building

UNIT III

Alternative building materials for low cost housing

Introduction - Substitute for scarce materials – Ferro-cement - Gypsum boards - Timber substitutions - Industrial wastes - Agricultural wastes - alternative building maintenance

Low cost Infrastructure services:

Introduce - Present status - Technological options - Low cost sanitation - Domestic wall - Water supply, energy

UNIT IV

Rural Housing: Introduction traditional practice of rural housing continuous - Mud Housing technology Mud roofs - Characteristics of mud - Fire treatment for thatch roof - Soil stabilization - Rural Housing programs



UNIT V

Housing in Disaster prone areas:

Introduction – Earthquake - Damages to houses - Traditional prone areas - Type of Damages and Railways of non-engineered buildings - Repair and restore action of earthquake Damaged non-engineered buildings recommendations for future constructions. Requirement's of structural safety of thin precast roofing units against Earthquake forces Status of R& D in earthquake strengthening measures - Floods, cyclone, future safety

Textbooks:

1. Building materials for low – income houses – International council for building research studies and documentation.
2. Hand book of low cost housing by A.K.Lal – Newage international publishers.
3. Low cost Housing – G.C. Mathur by South Asia Books

Reference Books:

1. Properties of concrete – Neville A.m. Pitman Publishing Limited, London.
2. Light weight concrete, Academic Kiado, Rudhai.G – Publishing home of Hungarian Academy of Sciences 1963.
3. Modern trends in housing in developing countries – A.G. Madhava Rao, D.S. Rama chandra Murthy &G.Annamalai. E. & F. N. Spon Publishers

Online Learning Resources:

<https://nptel.ac.in/courses/124107001>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem **L T P C**
3 0 0 3
(20A02704) IoT APPLICATIONS IN ELECTRICAL ENGINEERING
(Open Elective Course – III)

Course Objectives:

- Understand basics of Internet of Things and Micro Electro Mechanical Systems (MEMS) fundamentals in design and fabrication process
- Analyze motion less and motion detectors in IoT applications
- Understand about Analyze applications of IoT in smart grid
- Apply the concept of Internet of Energy for various applications

Course Outcomes:

- Understand the concept of IoT in Electrical Engineering
- Analyze various types of motionless sensors and various types of motion detectors
- Apply various applications of IoT in smart grid
- Design future working environment with Energy internet

UNIT I SENSORS

Definitions, Terminology, Classification, Temperature sensors, Thermoresistive, Resistance, temperature detectors, Silicon resistive thermistors, Semiconductor, Piezoelectric, Humidity and moisture sensors. Capacitive, Electrical conductivity, Thermal conductivity, time domain reflectometer, Pressure and Force sensors: Piezoresistive, Capacitive, force, strain and tactile sensors, Strain gauge, Piezoelectric

UNIT II OCCUPANCY AND MOTION DETECTORS

Capacitive occupancy, Inductive and magnetic, potentiometric - Position, displacement and level sensors, Potentiometric, Capacitive, Inductive, magnetic velocity and acceleration sensors, Capacitive, Piezoresistive, piezoelectric cables, Flow sensors, Electromagnetic, Acoustic sensors - Resistive microphones, Piezoelectric, Photo resistors

UNIT III MEMS

Basic concepts of MEMS design, Beam/diaphragm mechanics, electrostatic actuation and fabrication, Process design of MEMS based sensors and actuators, Touch sensor, Pressure sensor, RF MEMS switches, Electric and Magnetic field sensors

UNIT IV IoT FOR SMART GRID

Driving factors, Generation level, Transmission level, Distribution level, Applications, Metering and monitoring applications, Standardization and interoperability, Smart home

UNIT V INTERNET of ENERGY (IoE)

Concept of Internet of Energy, Evaluation of IoE concept, Vision and motivation of IoE, Architecture, Energy routines, information sensing and processing issues, Energy internet as smart grid

Textbooks:

1. Jon S. Wilson, Sensor Technology Hand book, Newnes Publisher, 2004
2. Tai Ran Hsu, MEMS and Microsystems: Design and manufacture, 1st Edition, Mc Grawhill Education, 2017
3. Ersan Kabalci and Yasin Kabalci, From Smart grid to Internet of Energy, 1st Edition, Academic Press, 2019

Reference Books:

1. Raj Kumar Buyya and Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Kindle Edition, Morgan Kaufmann Publisher, 2016
2. Yen Kheng Tan and Mark Wong, Energy Harvesting Systems for IoT Applications: Generation, Storage and Power Management, 1st Edition, CRC Press, 2019
3. RMD Sundaram Shriram, K. Vasudevan and Abhishek S. Nagarajan, Internet of Things,



Wiley, 2019

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs96/preview
2. <https://nptel.ac.in/courses/108108123>
3. <https://nptel.ac.in/courses/108108179>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem

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(20A04705) ELECTRONIC SENSORS
(Open Elective Course –III)

Course Objectives:

- Learn the characterization of sensors.
- Known the working of Electromechanical, Thermal, Magnetic and radiation sensors
- Understand the concepts of Electro analytic and smart sensors
- Able to use sensors in different applications

Course Outcomes:

- Learn about sensor Principle, Classification and Characterization.
- Explore the working of Electromechanical, Thermal, Magnetic, radiation and Electro analytic sensors
- Understand the basic concepts of Smart Sensors
- Design a system with sensors

UNIT I

Sensors / Transducers: Principles, Classification, Parameters, Characteristics, Environmental Parameters (EP), Characterization

Electromechanical Sensors: Introduction, Resistive Potentiometer, Strain Gauge, Resistance Strain Gauge, Semiconductor Strain Gauges -Inductive Sensors: Sensitivity and Linearity of the Sensor – Types-Capacitive Sensors: Electrostatic Transducer, Force/Stress Sensors Using Quartz Resonators, Ultrasonic Sensors

UNIT II

Thermal Sensors: Introduction, Gas thermometric Sensors, Thermal Expansion Type Thermometric Sensors, Acoustic Temperature Sensor ,Dielectric Constant and Refractive Index thermo sensors, Helium Low Temperature Thermometer ,Nuclear Thermometer ,Magnetic Thermometer ,Resistance Change Type Thermometric Sensors, Thermo emf Sensors, Junction Semiconductor Types, Thermal Radiation Sensors, Quartz Crystal Thermoelectric Sensors, NQR Thermometry, Spectroscopic Thermometry, Noise Thermometry, Heat Flux Sensors

UNIT III

Magnetic sensors: Introduction, Sensors and the Principles Behind, Magneto-resistive Sensors, Anisotropic Magneto resistive Sensing, Semiconductor Magneto resistors, Hall Effect and Sensors, Inductance and Eddy Current Sensors, Angular/Rotary Movement Transducers, Synchros.

UNIT IV

Radiation Sensors: Introduction, Basic Characteristics, Types of Photo resistors/ Photo detectors, Xray and Nuclear Radiation Sensors, Fibre Optic Sensors

Electro analytical Sensors: The Electrochemical Cell, The Cell Potential - Standard Hydrogen Electrode (SHE), Liquid Junction and Other Potentials, Polarization, Concentration Polarization, Reference Electrodes, Sensor Electrodes, Electro ceramics in Gas Media.

UNIT V

Smart Sensors: Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing - Data Communication, Standards for Smart Sensor Interface, the Automation Sensors –Applications: Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing – Sensors for environmental Monitoring

Textbooks:

1. “Sensors and Transducers - D. Patranabis” –PHI Learning Private Limited., 2003.
2. Introduction to sensors- John veteline, aravindraghu, CRC press, 2011



References: 1. Make sensors: Terokarvinen, kemo, karvinen and villeyvaltokari, 1st edition, maker media, 2014.

Sensors handbook- Sabriesoloman, 2nd Ed. TMH, 2009

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem

L	T	P	C
3	0	0	3

(20A05704a) WEB TECHNOLOGIES
(Open Elective-III)

Course Objectives:

The course is designed to Introduce the key technologies that have been developed as part of the birth and maturation of the World Wide Web.

Course Outcomes:

- Understand the Web essentials.
- Develop web pages using XHTML
- Apply style to web pages using CSS
- Write scripts for client side
- Develop and transform XML documents.

UNIT I Web Essentials: Clients, Servers, and Communication

The Internet, Basic Internet protocols, WWW, HTTP request message, HTTP response message, Web clients, Web Servers, Case study.

UNIT II Markup Languages: XHTML 1.0

An introduction to HTML, Basic XHTML syntax and semantics, fundamental HTML elements, Relative URLs, Lists, Tables, Frames, Forms, Defining XHTML's abstract syntax, Creating HTML documents.

UNIT III Cascading Style Sheets

Introduction, features, core syntax, style sheets and HTML, style rule cascading and inheritance, text properties, Box model, normal flow box layout, beyond the normal flow, lists, tables, cursor styles.

UNIT IV Client-side programming: JavaScript

Basic syntax, variables and data types, statements, operators, literals, functions, objects, Arrays, built-in objects, JavaScript debuggers.

UNIT V Representing Web Data: XML

Documents and vocabularies, Versions and declaration, Namespaces, Ajax, DOM and SAX parsers, transforming XML documents, XPath, XSLT, Displaying XML documents in Web browsers.

Textbooks:

1. J.C. Jackson, Web technologies: A computer science perspective, Pearson.

Reference Books:

1. Sebesta, Programming world wide web, Pearson.
2. Dietel and Nieto, Internet and World Wide Web – How to program, Pearson Education
3. Chris Bates, Web Programming, building internet applications, 2nd edition, WILEY, Dreamtech

Online Learning Resources:

<http://getbootstrap.com/>

<https://www.w3schools.com/whatis/>

<https://nptel.ac.in/courses/106105084>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem

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(20A05704b) VR & AR FOR ENGINEERS
(Open Elective Course – III)

Course Objectives:

- Introduce to the design of visualization tools
- Demonstrate Virtual reality
- Learn Virtual reality animation and 3D Art optimization
- Understand the foundational principles describing how hardware, computer vision algorithms function
- Explore the history of spatial computing and design interactions

Course Outcomes:

- Apply VR/MR/AR in various fields in industry
- Design Data visualization tools
- Design audio and video interaction paradigms
- Apply technical and creative approaches to make successful applications and experiences.
- Explain how the humans interact with computers

UNIT I

Computer generated worlds: what is augmented reality? what is virtual reality?

Understanding virtual space: defining visual space and content, defining position and orientation in three dimensions, navigation

The Mechanics of Sight: the visual path way, spatial vision, and Depth Cues.

Component Technologies of Head mounted Displays: Display fundamentals, related terminology and concepts, optical Architectures.

UNIT II

Augmented Displays: Binocular augmenting displays, Monocular augmenting displays.

Fully immersive Displays: PC-Console driven displays, smartphone based displays, CAVES and Walls, Hemispheres and Domes.

The Mechanics of hearing: Defining sound, the auditory pathway, sound cues and localization, the vestibular system.

Audio displays: Conventional audio

UNIT III

The Mechanics of Feeling: The Science of feeling, Anatomy and Composition of the skin.

Tactile and force feedback Devices: Haptic illusions, tactile feedback devices, Force feedback devices.

Sensors for tracking Position, and orientation and motion: introduction to sensor technologies, optical trackers, beacon trackers, electromagnetic trackers, inertial sensors, acoustic sensors.

Devices to enable navigation and interaction: 2D vs 3D interaction and navigation, the importance of a manual interface, hand and gesture tracking, whole body tracking, gaming and entertainment interfaces, navigating with your mind.

UNIT IV

Gaming and Entertainment: Virtual reality and the arts, gaming, immersive video/ cinematic virtual reality.

Architecture and Construction: Artificial spaces, architectural design: Manage group architectures, Construction management, real estate sales applications, architectural acoustics.



Science and engineering: Simulate and innovate, naval architecture and marine engineering, automotive engineering, aerospace engineering, nuclear engineering and manufacturing.

Health and medicine: advancing the field of medicine, training applications, treatment applications.

UNIT V

Aerospace and Defence: Flight simulation and training, mission planning and rehearsal, dismounted soldier situational awareness, advanced cockpit avionics, space operations.

Education: Tangible skills education, theory, knowledge acquisition and concept formation.

Information control and big data visualization: What is big data?, big data analytics and human vision.

Telerobotics and Telepresence: Defining Telerobotics and Telepresence, space applications and robonaut, undersea applications, Terrestrial and airborne applications.

Textbooks:

1. Steve Aukstakalnis, "Practical Augmented Reality", Pearson Education, 2017.

Reference Books:

1. Erin Pangilinan, Steve lukas, and Vasanth Mohan, "Creating Augmented& Virtual Realities", O'REILLY

Online Learning Resources:

1. <https://www.coursera.org/learn/intro-augmented-virtual-mixed-extended-reality-technologies-applications-issues>
2. <https://www.coursera.org/learn/ar>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem

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(20A05704c) AGILE METHODOLOGIES
(Open Elective Course – III)

Course Objectives:

- To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand the benefits and pitfalls of working in an Agile team.
- To understand Agile development and testing.

Course Outcomes:

- Realize the importance of interacting with business stakeholders in determining the requirements for a software system
- Perform iterative software development processes: how to plan them, how to execute them.
- Point out the impact of social aspects on software development success.
- Develop techniques and tools for improving team collaboration and software quality
- Perform Software process improvement as an ongoing task for development teams
- Show how agile approaches can be scaled up to the enterprise level.

UNIT I AGILE METHODOLOGY

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values

UNIT II AGILE PROCESSES

Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

UNIT III AGILITY&KNOWLEDGE MANAGEMENT

Agile Information Systems – Agile Decision Making - Earl_S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment, leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

UNIT IV AGILITY AND REQUIREMENTS ENGINEERING

Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

UNIT V AGILITY AND QUALITY ASSURANCE

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Test Driven Development – Agile Approach in Global Software Development.

Textbooks:

1. David J. Anderson and Eli Schragenheim, —Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.
2. Hazza and Dubinsky, —Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009.

Reference Books:

1. Craig Larman, —Agile and Iterative Development: A Manager's Guide, Addison-Wesley, 2004.
2. Kevin C. Desouza, —Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007.

Online Learning Resources: <https://www.udemy.com/course/foundations-of-agile-software-testing-j>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem **L T P C**
3 0 0 3

(20A27704) HUMAN NUTRITION
(OPEN ELECTIVE-III)

Course Objectives:

- To get knowledge on Concepts and content of nutrition source and metabolic functions.
- To know about Balanced diets for various groups; Diets and disorders, recommended dietary allowances
- To learn about Epidemiology of under nutrition and over nutrition.
- To understand Nutrition and immunity.

Course Outcomes:

- To study the Salient features of Concepts and content of nutrition, Malnutrition, Nutrition education
- Assessment of nutritional status, disorders Food fad and faddism.

UNIT I

Concepts and content of nutrition: Nutrition agencies; Nutrition of community; Nutritional policies and their implementation; Metabolic function of nutrients. Nutrients: Sources, functions, digestion, absorption, assimilation and transport of carbohydrates, proteins and fats in human beings;

UNIT II

Water and energy balance: Water intake and losses; Basal metabolism- BMR; Body surface area and factors affecting BMR Formulation of diets: Classification of balanced diet; Balanced diets for various groups; Diets and disorders. Recommended dietary allowances (RDA); For various age group; According physiological status; Athletic and sports man; Geriatric persons

UNIT III

Malnutrition: Type of Malnutrition; Multi-factorial causes; Epidemiology of under nutrition and over nutrition; Nutrition and immunity.

UNIT IV

Nutrition education Assessment of nutritional status: Diet surveys; Anthropometry; Clinical examination; Biochemical assessment; Additional medical information

UNIT V

Blood constituents; Hormone types; Miscellaneous disorders Food fad and faddism. Potentially toxic substances in human food.

Textbooks:

1. Swaminathan M, Advanced Text Book on Food & Nutrition (Volume I and II) , The Bangalore Printing and Publishing Co.Ltd, Bangalore. 2006
2. Stewart Truswell, ABC of Nutrition (4th edition) , BMJ Publishing Group 2003, ISBN 0727916645.
3. Martin Eastwood, Principles of Human Nutrition , Blackwell Publishing, Boca Rotan

Reference:

1. Mike Lean and E. Combet ,Barasi's Human Nutrition – A Health Perspective , Second Edition CRC Press, London
2. Introduction to Human Nutrition, Micheal J. G., Susan A.L. Aedin C. and Hester H.V, Wiley-Blackwell Publication, UK 2009 , ISBN 9781405168076
3. Bogert L.J., Goerge M.B, Doris H.C., Nutrition and Physical Fitness, W.B. Saunders Company, Toronto, Canada



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem

L	T	P	C
3	0	0	3

(20A54702) NUMERICAL METHODS FOR ENGINEERS
(OPEN ELECTIVE-III)

Course Objectives:

This course aims at providing the student with the knowledge on various numerical methods for solving equations, interpolating the polynomials, evaluation of integral equations and solution of differential equations.

Course Outcomes:

- Apply numerical methods to solve algebraic and transcendental equations.
- Understand fitting of several kinds of curves.
- Derive interpolating polynomials using interpolation formulae.
- Solve differential and integral equations numerically.

UNIT I Solution of Algebraic & Transcendental Equations

Introduction-Bisection Method-Iterative method-Regula falsi method-Newton Raphson method.
System of Algebraic equations: Gauss Jordan method-Gauss Siedal method.

UNIT II Curve Fitting

Principle of Least squares- Fitting of curves- Fitting of linear, quadratic and exponential curves.

UNIT III Interpolation

Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae
Gauss forward and backward formula, Stirling's formula, Bessel's formula

UNIT IV Numerical Integration

Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule

UNIT V Solution of Initial value problems to Ordinary differential equations

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Modified Euler's Method-Runge-Kutta Methods.

Textbooks:

1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
2. Probability and Statistics for Engineers and Scientists, Ronald E. Walpole, PNIE.
3. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India

Reference Books:

1. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
2. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier.

Online Learning Resources:

<https://slideplayer.com/slide/8588078/>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem **L T P C**
3 0 0 3
(20A56702) SENSORS AND ACTUATORS FOR ENGINEERING APPLICATIONS
(OPEN ELECTIVE-III)

Course Objectives:

- To provide exposure to various kinds of sensors and actuators and their engineering applications.
- To impart knowledge on the basic laws and phenomenon behind the working of sensors and actuators
- To enlighten the operating principles of various sensors and actuators
- To educate the fabrication of sensors
- To identify the required sensor and actuator for interdisciplinary application

Course Outcomes:

- To recognize the need of sensors and actuators
- To understand working principles of various sensors and actuators
- To identify different type of sensors and actuators used in real life applications
- To exploit basics in common methods for converting a physical parameter into an electrical quantity
- To make use of sensors and actuators for different applications

UNIT I Introduction to Sensors and Actuators

Sensors: Types of sensors: temperature, pressure, strain, active and passive sensors, General characteristics of sensors (Principles only), Materials used and their fabrication process: Deposition: Chemical Vapor Deposition, Pattern: photolithography and Etching: Dry and Wet Etching.

Actuators: Functional diagram of actuators, Types of actuators and their basic principle of working: Hydraulic, Pneumatic, Mechanical, Electrical, Magnetic, Electromagnetic, piezo-electric and piezo-resistive actuators, Simple applications of Actuators.

UNIT II Temperature and Mechanical Sensors

Temperature Sensors: Types of temperature sensors and their basic principle of working: Thermo-resistive sensors: Thermistors, Resistance temperature sensors, Silicon resistive sensors, Thermo-electric sensors: Thermocouples, PN junction temperature sensors

Mechanical Sensors: Types of Mechanical sensors and their basic principle of working: Force sensors: strain gauges, tactile sensors, Pressure sensors: semiconductor, piezoresistive, capacitive, VRP.

UNIT III Optical and Acoustic Sensors

Optical Sensors: Basic principle and working of: Photodiodes, Phototransistors and Photo-resistors based sensors, Photomultipliers, Infrared sensors: thermal, PIR, thermopiles

Acoustic Sensors: Principle and working of Ultrasonic sensors, Piezo-electric resonators, Microphones.

UNIT IV Magnetic, Electromagnetic Sensors and Actuators

Motors as actuators (linear, rotational, stepping motors), magnetic valves, inductive sensors (LVDT, RVDT, and Proximity), Hall Effect sensors, Magneto-resistive sensors, Magneto-strictive sensors and actuators, Voice coil actuators (speakers and speaker-like actuators).

UNIT V Chemical and Radiation Sensors

Chemical Sensors: Principle and working of Electro-chemical, Thermo-chemical, Gas, pH, Humidity and moisture sensors.

Radiation Sensors: Principle and working of Ionization detectors, Scintillation detectors, Geiger-Mueller counters, Semiconductor radiation detectors and Microwave sensors (resonant, reflection, transmission)



Textbooks:

1. Sensors and Actuators – Clarence W. de Silva, CRC Press, 2nd Edition, 2015
2. Sensors and Actuators, D.A.Hall and C.E.Millar, CRC Press, 1999

Reference Books:

1. Sensors and Transducers- D.Patranabhis, Prentice Hall of India (Pvt) Ltd. 2003
2. Measurement, Instrumentation, and Sensors Handbook-John G.Webster, CRC press 1999
3. Sensors – A Comprehensive Sensors- Henry Bolte, John Wiley.
4. Handbook of modern sensors, Springer, Stefan Johann Rupitsch.
5. Principles of Industrial Instrumentation By D. Patranabhis

NPTEL courses links

https://onlinecourses.nptel.ac.in/noc21_ee32/preview



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem **L T P C**
3 0 0 3
(20A51702) CHEMISTRY OF NANOMATERIALS AND APPLICATIONS
(OPEN ELECTIVE-III)

Course Objectives:

- To understand synthetic principles of Nanomaterials by various methods
- To characterize the synthetic nanomaterials by various instrumental methods
- To enumerate the applications of nanomaterials in engineering

Course Outcomes:

- Understand the state of art synthesis of nano materials
- Characterize nano materials using ion beam, scanning probe methodologies, position sensitive atom probe and spectroscopic ellipsometry.
- Analyze nanoscale structure in metals, polymers and ceramics
- Analyze structure-property relationship in coarser scale structures
- Understand structures of carbon nano tubes

UNIT I

Introduction: Scope of nanoscience and nanotechnology, nanoscience in nature, classification of nanostructured materials, importance of nano materials.

Synthetic Methods: Bottom-Up approach: Sol-gel synthesis, microemulsions or reverse micelles, co-precipitation method, solvothermal synthesis, hydrothermal synthesis, microwave heating synthesis and sonochemical synthesis.

UNIT II

Top-Down approach: Inert gas condensation, arc discharge method, aerosol synthesis, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, and chemical vapour deposition method, electrodeposition method, high energy ball milling.

UNIT III

Techniques for characterization: Diffraction technique, spectroscopy techniques, electron microscopy techniques for the characterization of nanomaterials, BET method for surface area analysis, dynamic light scattering for particle size determination.

UNIT IV

Studies of Nano-structured Materials: Synthesis, properties and applications of the following nanomaterials, fullerenes, carbon nanotubes, core-shell nanoparticles, nanoshells, self- assembled monolayers, and monolayer protected metal nanoparticles, nanocrystalline materials, magnetic nanoparticles and important properties in relation to nanomagnetic materials, thermoelectric materials, non-linear optical materials, liquid crystals.

UNIT V

Engineering Applications of Nanomaterials

Textbooks:

1. NANO: The Essentials: T Pradeep, McGraw-Hill, 2007.
2. Textbook of Nanoscience and nanotechnology: B S Murty, P Shankar, Baldev Rai, BB Rath and James Murday, Univ. Press, 2012.

References:

1. Concepts of Nanochemistry; Ludovico Cademrtiri and Geoffrey A. Ozin & Geoffrey A. Ozin, Wiley-VCH, 2011.
2. Nanostructures & Nanomaterials; Synthesis, Properties & Applications: Guozhong Cao, Imperial College Press, 2007.
3. Nanomaterials Chemistry, C. N. R. Rao, Achim Muller, K.Cheetham, Wiley-VCH, 2007.



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem
L T P C
3 0 0 3

(20A52703) CONSTITUTION OF INDIA

Course Objectives:

- To Enable the student to understand the importance of constitution
- To understand the structure of executive, legislature and judiciary
- To understand philosophy of fundamental rights and duties
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and Election Commission of India.
- To understand the central-state relation in financial and administrative control

Course Outcomes:

- Understand historical background of the constitution making and its importance for building a democratic India.
- Understand the functioning of three wings of the government ie., executive, legislative and judiciary.
- Understand the value of the fundamental rights and duties for becoming good citizen of India.
- Analyze the decentralization of power between central, state and local self-government
- Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.

UNIT I

Introduction to Indian Constitution – Constitution -Meaning of the term - Indian Constitution- Sources and constitutional history - Features– Citizenship – Preamble - Fundamental Rights and Duties - Directive Principles of State Policy.

UNIT II

Union Government and its Administration Structure of the Indian Union - Federalism - Centre-State relationship – President’s Role, power and position - PM and Council of ministers - Cabinet and Central Secretariat –Lok Sabha - Rajya Sabha - The Supreme Court and High Court - Powers and Functions

UNIT III

State Government and its Administration - Governor - Role and Position -CM and Council of ministers - State Secretariat-Organization Structure and Functions

UNIT IV

Local Administration - District’s Administration Head - Role and Importance - Municipalities - Mayor and role of Elected Representatives -CEO of Municipal Corporation Pachayati Raj - Functions– PRI –Zilla Parishath - Elected officials and their roles – CEO,Zilla Parishath - Block level Organizational Hierarchy - (Different departments) - Village level - Role of Elected and Appointed officials - Importance of grass root democracy

UNIT V

Election Commission - Election Commission- Role of Chief Election Commissioner and Election Commissionerate - State Election Commission -Functions of Commissions for the welfare of SC/ST/OBC and Women

Textbooks:

1. Durga Das Basu, “ Introduction to the Constitution of India”, Prentice – Hall of India Pvt. Ltd.. New Delhi
2. Subash Kashyap, “Indian Constitution”, National Book Trust

References:

1. J.A. Siwach, “Dynamics of Indian Government & Politics”.
2. H.M.Sreevai, “Constitutional Law of India”, 4th edition in 3 volumes (Universal Law Publication)
3. J.C. Johari, “Indian Government andPolitics”, Hans India
4. M.V. Pylee, “Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice”, Hall of India Pvt. Ltd.. New Delhi



E-Resources:

1. nptel.ac.in/courses/109104074/8 2. nptel.ac.in/courses/109104045/
2. nptel.ac.in/courses/101104065/ 4. www.hss.iitb.ac.in/en/lecture-details,
www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR				
B.Tech IV-I Sem	L	T	P	C
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**(20A01706) HEALTH, SAFETY AND ENVIRONMENTAL MANAGEMENT PRACTICES
(Open Elective Course-IV)**

Course Objectives:

- To understand safety, health and environmental management.
- To be familiar with hazard classification and assessment, hazard evaluation and hazard control, environmental issues and management
- To get exposed to accidents modeling, accident investigation and reporting, concepts of HAZOP and PHA
- To be familiar with safety measures in design and process operations.
- To get exposed to risk assessment and management, principles and methods

Course Outcomes :

- To understand safety, health and environmental management.
- To be familiar with hazard classification and assessment, hazard evaluation and hazard.
- To get exposed to accidents modelling, accident investigation and reporting control, environmental issues and management
- To get concepts of HAZOP and PHA.
- To be familiar with safety measures in design and process operations.

UNIT I

Introduction to safety, health and environmental management - Basic terms and their definitions - Importance of safety - Safety assurance and assessment - Safety in design and operation - Organizing for safety.

UNIT II

Hazard classification and assessment - Hazard evaluation and hazard control.
Environmental issues and Management - Atmospheric pollution - Flaring and fugitive release - Water pollution - Environmental monitoring - Environmental management.

UNIT III

Accidents modelling - Release modelling - Fire and explosion modelling - Toxic release and dispersion Modelling

UNIT IV

Accident investigation and reporting - concepts of HAZOP and PHA.
Safety measures in design and process operations - Inserting, explosion, fire prevention, sprinkler systems.

UNIT V

Risk assessment and management - Risk picture - Definition and characteristics - Risk acceptance criteria - Quantified risk assessment - Hazard assessment - Fatality risk assessment - Risk management principles and methods.

Textbooks:

1. Process Safety Analysis, by Skelton. B, Gulf Publishing Company, Houston, 210pp., 1997.
2. Risk Management with Applications from Offshore Petroleum Industry, by Terje Aven and Jan Erik Vinnem, Springer, 200pp., 2007.

Reference Books:

1. Introduction to Safety and Reliability of Structures, by Jorg Schneider
2. Structural Engineering Documents Vol. 5, International Association for Bridge and



- Structural Engineering (IABSE), 138pp., 1997.
3. Safety and Health for Engineers, by Roger L. Brauer, John Wiley and Sons Inc. pp. 645-663, 2006.
 4. Health, Safety and Environmental Management in Offshore and Petroleum Engineering, Srinivasan Chandrasekaran, John Wiley and Sons, 2016.

Online Learning Resources:

<https://nptel.ac.in/courses/114106017>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem **L T P C**
3 0 0 3

(20A02705) RENEWABLE ENERGY SYSTEMS
(Open Elective Course – IV)

Course Objectives:

- Understand various sources of Energy and the need of Renewable Energy Systems.
- Understand the concepts of Solar Radiation, Wind energy and its applications.
- Analyze solar thermal and solar PV systems
- Understand the concept of geothermal energy and its applications, biomass energy, the concept of Ocean energy and fuel cells.

Course Outcomes:

- Understand various alternate sources of energy for different suitable application requirements
- Understand the concepts of solar energy generation strategies and wind energy system
- Analyze Solar and Wind energy systems
- Understand the basics of Geothermal Energy Systems, various diversified energy scenarios of ocean, biomass and fuel cells

UNIT I SOLAR ENERGY

Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, storage of solar energy-thermal storage.

UNIT II PV ENERGY SYSTEMS

Introduction, The PV effect in crystalline silicon basic principles, the film PV, Other PV technologies, Electrical characteristics of silicon PV cells and modules, PV systems for remote power, Grid connected PV systems.

UNIT III WIND ENERGY

Principle of wind energy conversion; Basic components of wind energy conversion systems; windmill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.

UNIT IV GEOTHERMAL ENERGY

Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.

UNIT V MISCELLANEOUS ENERGY TECHNOLOGIES

Ocean Energy: Tidal Energy-Principle of working, performance and limitations. Wave Energy-Principle of working, performance and limitations.

Bio mass Energy: Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration

Fuel cell: Principle of working of various types of fuel cells and their working, performance and limitations.

Textbooks:

1. Stephen Peake, “Renewable Energy Power for a Sustainable Future”, Oxford International Edition, 2018.
2. G. D. Rai, “Non-Conventional Energy Sources”, 4th Edition, Khanna Publishers, 2000.



Reference Books:

1. S. P. Sukhatme, “Solar Energy”, 3rd Edition, Tata Mc Graw Hill Education Pvt. Ltd, 2008.
2. B H Khan , “ Non-Conventional Energy Resources”, 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011.
3. S. Hasan Saeed and D.K.Sharma, “Non-Conventional Energy Resources”, 3rd Edition, S.K.Kataria& Sons, 2012.
4. G. N. Tiwari and M.K.Ghosal, “Renewable Energy Resource: Basic Principles and Applications”, Narosa Publishing House, 2004.

Online Learning Resources:

1. <https://nptel.ac.in/courses/103103206>
2. <https://nptel.ac.in/courses/108108078>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem
(20A04706) MICROCONTROLLERS & APPLICATIONS
(Open Elective Course –IV)

L	T	P	C
3	0	0	3

Course Objectives:

- Describe the Architecture of 8051 Microcontroller and Interfacing of 8051 to external memory.
- Write 8051 Assembly level programs using 8051 instruction set.
- Describe the Interrupt system, operation of Timers/Counters and Serial port of 8051.
- Interface simple switches, simple LEDs, ADC 0804, LCD and Stepper Motor to 8051.

Course Outcomes:

- Understand the importance of Microcontroller and Acquire the knowledge of Architecture of 8051 Microcontroller.
- Apply and Interface simple switches, simple LEDs, ADC 0804, LCD and Stepper Motor to using 8051 I/O ports.
- Develop the 8051 Assembly level programs using 8051 Instruction set
- Design the Interrupt system, operation of Timers/Counters and Serial port of 8051

UNIT 1 8051 Microcontroller:

Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.

UNIT II

Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples to use these instructions.

UNIT III

8051 Stack, Stack and Subroutine instructions. Simple Assembly language program examples to use subroutine instructions. 8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin.

UNIT IV

8051 Serial Communication- Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially. 8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch.

UNIT V

8051 C programming to generate a square waveform on a port pin using a Timer interrupt. Interfacing 8051 to ADC-0804, DAC, LCD and Interfacing with relays and opto isolators, Stepper Motor Interfacing, DC motor interfacing, PWM generation using 8051.

Textbooks:

1. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; “The 8051 Microcontroller and Embedded Systems – using assembly and C”, PHI, 2006 / Pearson, 2006.
2. Kenneth J. Ayala, “The 8051 Microcontroller”, 3rd Edition, Thomson/Cengage Learning.

References:

1. Manish K Patel, “The 8051 Microcontroller Based Embedded Systems”, McGraw Hill, 2014, ISBN: 978-93-329-0125-4.
2. Raj Kamal, “Microcontrollers: Architecture, Programming, Interfacing and System Design”, Pearson Education, 2005.



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem

L	T	P	C
3	0	0	3

(20A05705a) CYBER SECURITY
(Open Elective-III)

Course Objectives:

The course is designed to provide awareness on different cyber crimes, cyber offenses, tools and methods used in cybercrime.

Course Outcomes:

- Classify the cybercrimes and understand the Indian ITA 2000
- Analyse the vulnerabilities in any computing system and find the solutions
- Predict the security threats of the future
- Investigate the protection mechanisms
- Design security solutions for organizations

UNIT I Introduction to Cybercrime

Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

UNIT II Cyber Offenses: How Criminals Plan Them

Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber Cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing

UNIT III Cybercrime: Mobile and Wireless Devices

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT IV Tools and Methods Used in Cybercrime

Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

UNIT V Cyber Security: Organizational Implications

Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

Textbooks:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.

Reference Books:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu, J. David Irwin. CRC Press T&F Group

Online Learning Resources:

<http://nptel.ac.in/courses/106105031/40>
<http://nptel.ac.in/courses/106105031/39>
<http://nptel.ac.in/courses/106105031/38>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem **L T P C**
3 0 0 3

(20A05705b) FULL STACK DEVELOPMENT
(Open Elective Course – IV)

Course Objectives:

- To build foundation on HTML this will help developer to use HTML concepts for building responsive web application.
- To Develop HTML based Single application for Browsers.
- To Understand OOPs concepts and its applications by building competency in object –oriented Programming.
- To implement frontend and backend scenarios using Web Sockets.
- To become proficient in Bootstrap concepts.

Course Outcomes:

- Able to how to program a browser like using JavaScript, jQuery, Angular, or Vue.
- Distinguishing trends in multi-device implementation.
- Create webpages that function using external data.
- Disambiguate the different structures that a no SQL database may represent.
- Derive information from data and implement data into applications.

UNIT I

e The Modern Web: Rise of the Web, Mobile Web, The State of HTML, Applications vs Web Sites, Keeping Up.

Planning Your Work: Identifying Requirements, Defining the Work, Tracking the Work Continuous Improvement, Prioritization & Estimation, Managing Bugs, Continuous Delivery

User Experience: Information Architecture, Getting the User Experience Right, Polishing the User Experience, Implementing the User Experience.

UNIT II

Designing Systems: System Architectures, Identifying Concepts, Identifying User Interactions, Handling Commonalities, Working with Legacy and External Dependencies, Component Interactions, Applications vs. Modules, Cross-Functional Requirements, Caching, Designing for Failure, Designing Modules, Refactoring, Tools, Changing Your Architecture.

Ethics: Privacy, Cognitive Load, Energy Usage, Trust.

Front End: HTML, From Server to Browser, Styling, Components, Responsive Design, Progressive Enhancement to Progressively Enhance, or Not? Mobile First, Feature Detection, Progressive Enhancement of Style, When Not Using Progressive Enhancement, Search Engine Optimization, Build Tools.

UNIT III

Testing: Test-Driven Development, Test Pyramid, Behaviour-Driven Development, Three Amigos, Manual Testing, Visual Testing, Cross-Functional Testing,

JavaScript: Asynchronicity, JavaScript in the Browser, Offline-First Development, Document Object Model, Server-Side JavaScript, Table of Contents viii JavaScript Modules, Structuring Your JavaScript, JavaScript Types, Object-Oriented Programming, Functional Programming, Communicating Between Components, Connecting Components Together, Testing, Build Tools.

Accessibility: Accessible from the Start, Working with Assistive Technologies, Dealing with Interactive UI, Testing for Accessibility, Avoiding Common Mistakes.

UNIT IV

APIs: API Responsibilities, designing a REST API, Securing Your API, Event-Based APIs, Discovering APIs, Using APIs

Storing Data: Types of Databases, To SQL, or NoSQL?, Where to Store Your Data, Accessing Data from Your App, Managing Your Data, Protecting Your Data.

Security: Trust, Responding to Incidents, The Golden Rule, Threats, Security Checklists, Passwords, Indirect Attacks.



UNIT V

Deployment: Twelve Factor Apps, Developer Machines, Production Environments, Moving Code into Production, Configuring Your Box, Infrastructure, Immutable Infrastructure, Continuous Delivery & Continuous Deployment.

In Production: Fire Drills, Run Books, Monitoring, Responding to Incidents

Constant Learning: Collecting, Experiments, Analysing Results, Hypothesis-Driven.

Textbook:

1. Chris Northwood, The full Stack Developer, Apress, 2018.

Reference Books:

1. Modern Full-Stack Development: Using TypeScript, React, Node.js, Webpack, and Docker, Frank Zammetti.
2. Full Stack Web Development for Beginners, Riaz Ahmed.

Online Learning Resources:

1. [Learn Full Stack Web Development with 40+ Projects and Exercises | Udemy](#)



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem
(20A12705) INDUSTRIAL IOT
(Open Elective-IV)

L	T	P	C
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Course Objectives:

- Acquire theoretical knowledge on Industrial Internet of Things.
- Apply suitable machine learning techniques for data handling and to gain knowledge from it.
- Evaluate the performance of algorithms for sensors and data transmission.

Course Outcomes:

- Understand the characteristics of Internet of Things and its industry strategies.
- Apply various Internet of Things models to appropriate problems.
- Identify and integrate more than one technology to enhance the performance.
- Understand the sensors and data transmission used in Internet of Things.
- Analyse the co-occurrence of data to find interesting frequent patterns.
- Pre-process the data before applying to any real-world problem and can evaluate its performance.

UNIT I Overview of Internet of Things

Introduction, IOT Architecture, Application –based IOT protocols, Cloud Computing, Fog Computing, Sensor Cloud, Big Data.

Overview of Industry 4.0 and Industrial Internet of Things: IIoT- Prerequisites of IIOT, Basics of CPS, CPS and IIOT, Applications of IIoT.

UNIT II Industrial Internet of Things

Introduction, Industrial Internet Systems, Industrial sensing, Industrial sensing, Industrial Processes. Business Models and Reference Architecture of IIoT: Definition of a business model, Business models of IOT, Business models of IIOT.

UNIT III Key and On-site Technologies

Key Technologies: Off-site Technologies- Introduction, Cloud Computing- Necessity, Cloud Computing and IIoT, Industrial Cloud Platform Providers, SLA, Requirements of Industry 4.0, Fog Computing.

On-site Technologies- Introduction, Augmented Reality- History, Categorization, Applications, Virtual Reality- History, Categorization, Applications.

UNIT IV Sensors and Data Transmission

Sensors: Introduction to Sensors, Characteristics-Sensor calibration, Sensor profile, Operating voltage, Sensor Categories. Actuators: Introduction, Thermal Actuators, Hydraulic Actuators, Pneumatic Actuators, Electromechanical Actuators.

Industrial Data Transmission: Foundation fieldbus, Profibus, HART, Interbus, Bitbus.

UNIT V Machine learning and Data science, applications in healthcare

Machine Learning and Data Science in Industries: Introduction, Machine Learning, Categorization on ML, Applications and Data Science of ML in industries, Deep Learning, Applications of Deep Learning in industries.

Applications of Healthcare in Industries: Smart Devices, Advanced Technologies using in Healthcare, Open Research Issues to be Addressed.



Textbooks:

1. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.

Reference Books:

1. Industrial IoT. Available online: <https://medium.com/iotforall/whatproduct-managers-need-to-know-about-industrial-iot-8c92eec1d9d2>
2. IIoT Cloud Platforms. Available online: <https://fr.farnell.com/willthere-be-a-dominant-iiot-cloud-platform>.
3. Kajima, T. and Kawamura, Y., 1995. Development of a high-speed solenoid valve: Investigation of solenoids. IEEE Transactions on industrial electronics, 42(1), pp.1-8.

Online Learning Resources:

1. <https://www.coursera.org/learn/industrial-internet-of-things>
2. <https://www.coursera.org/specializations/developing-industrial-iiot>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem **L T P C**
3 0 0 3

(20A27705) WASTE AND EFFLUENT MANAGEMENT
(OPEN ELECTIVE-IV)

Course Objectives:

- To understand the wastewater treatment process.
- To gain knowledge on waste disposal in various ways.
- To know about advances in wastewater treatment.

Course Outcomes:

- Acquires knowledge on technologies used for chemical and biological methods of waste water and effluent treatment

UNIT I

Wastewater Treatment an Overview: Terminology – Regulations – Health and Environment Concerns in waste water management – Constituents in waste water inorganic – Organic and metallic constituents. Process Analysis and Selection: Components of waste water flows – Analysis of Data – Reactors used in waste water treatment – Mass Balance Analysis – Modeling of ideal and non ideal flow in Reactors – Process Selection

UNIT II

Waste disposal methods – Physical, Chemical & Biological; Economical aspects of waste treatment and disposal. Treatment methods of solid wastes: Biological composting, drying and incineration; Design of Solid Waste Management System: Landfill Digester, Vermicomposting Pit.

UNIT III

Introduction: Classification and characterization of food industrial wastes from Fruit and Vegetable processing industry, Beverage industry; Fish, Meat & Poultry industry, Sugar industry and Dairy industry.

Chemical Unit Processes: Role of unit processes in waste water treatment chemical coagulation – Chemical precipitation for improved plant performance chemical oxidation – Neutralization – Chemical Storage

UNIT IV

Biological Treatment: Overview of biological Treatment – Microbial metabolism – Bacterial growth and energetics – Aerobic biological oxidation – Anaerobic fermentation and oxidation – Trickling filters – Rotating biological contractors – Combined aerobic processes – Activated sludge film packing.

UNIT V

Advanced Wastewater Treatment: Technologies used in advanced treatment – Classification of technologies. Removal of Colloids and suspended particles – Depth Filtration – Surface Filtration – Membrane Filtration- Absorption – Ion Exchange – Advanced oxidation process.

Textbooks:

1. Herzka A & Booth RG; “Food Industry Wastes: Disposal and Recovery”; Applied Science Pub Ltd. 1981,
2. Fair GM, Geyer JC & Okun DA; “Water & Wastewater Engineering”; John Wiley & Sons, Inc. 1986,

References:

1. GE; “Symposium: Processing Agricultural & Municipal Wastes”; AVI. 1973,
2. Inglett Green JH & Kramer A; “Food Processing Waste Management”; AVI. 1979,
3. Rittmann BE & McCarty PL; “Environmental Biotechnology: Principles and Applications”; Mc-Graw-Hill International editions 2001,.
4. Bhattacharyya B C & Banerjee R; “Environmental Biotechnology”; Oxford University Press
5. Bartlett RE; “Wastewater Treatment; Applied Science” Pub Ltd.
6. G. Tchobanoglous, FI Biston, “Waste water Engineering Treatment and Reuse”: Mc Graw Hill, 2002.
7. “Industrial Waste Water Management Treatment and Disposal by Waste Water” 3rd Edition Mc Graw Hill 2008



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem **L T P C**
3 0 0 3
(20A54703) NUMBER THEORY AND ITS APPLICATIONS
(OPEN ELECTIVE-IV)

Course Objectives:

This course enables the students to learn the concepts of number theory and its applications to information security.

Course Outcomes:

- Understand number theory and its properties.
- Understand principles on congruences
- Develop the knowledge to apply various applications
- Develop various encryption methods and its applications.

UNIT I Integers, Greatest common divisors and prime Factorization

The well-ordering property-Divisibility-Representation of integers-Computer operations with integers-Prime numbers-Greatest common divisors-The Euclidean algorithm -The fundamental theorem of arithmetic-Factorization of integers and the Fermat numbers-Linear Diophantine equations

UNIT II Congruences

Introduction to congruences -Linear congruences-The Chinese remainder theorem-Systems of linear congruences

UNIT III Applications of Congruences

Divisibility tests-The perpetual calendar-Round-robin tournaments-Computer file storage and hashing functions. Wilson's theorem and Fermat's little theorem- Pseudo primes- Euler's theorem- Euler's ϕ function- The sum and number of divisors- Perfect numbers and Mersenne primes.

UNIT IV Finite fields & Primality, factoring

Finite fields- quadratic residues and reciprocity-Pseudo primes-rho method-fermat factorization and factor bases.

UNIT V Cryptology

Basic terminology-complexity theorem-Character ciphers-Block ciphers-Exponentiation ciphers-Public-key cryptography-Discrete logarithm-Knapsack ciphers- RSA algorithm-Some applications to computer science.

Textbooks:

1. Elementary number theory and its applications, Kenneth H Rosen, AT & T Information systems & Bell laboratories.
2. A course in Number theory & Cryptography, Neal Koblitz, Springer.

Reference Books:

1. An Introduction To The Theory Of Numbers, Herbert S. Zuckerman, Hugh L. Montgomery, Ivan Niven, wiley publishers
2. Introduction to Analytic number theory-Tom M Apostol, springer
3. Elementary number theory, VK Krishnan, Universities press

Online Learning Resources:

<https://www.slideshare.net/ItishreeDash3/a-study-on-number-theory-and-its-applications>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem **L T P C**
3 0 0 3

(20A56703) SMART MATERIALS AND DEVICES
(OPEN ELECTIVE-IV)

Course Objectives:

- To provide exposure to smart materials and their engineering applications.
- To impart knowledge on the basics and phenomenon behind the working of smart materials
- To enlighten the properties exhibited by smart materials
- To educate various techniques used to synthesize and characterize smart materials
- To identify the required smart material for distinct applications/devices

Course Outcomes:

- to recognize the need of smart materials
- to understand the working principles of smart materials
- to know different techniques used to synthesize and characterize smart materials
- to exploit the properties of smart materials
- to make use of smart materials for different applications

UNIT I

Introduction: Historical account of the discovery and development of smart materials, Two phases: Austenite and Martensite, Temperature induced phase changes, Shape memory effect, Pseudoelasticity, One-way shape memory effect, Two-way shape memory effect.

UNIT II: Properties of Smart Materials: Physical principles of optical, Electrical, Dielectric, Piezoelectric, Ferroelectric, Pyroelectric and Magnetic properties of smart materials

UNIT III: Synthesis of smart materials: Solid state reaction technique, Chemical route: Chemical vapour deposition, Sol-gel technique, Hydrothermal method, Co-precipitation. Green synthesis, Mechanical alloying and Thin film deposition techniques: Chemical etching, Sol-gel, spray pyrolysis.

UNIT IV: Characterization techniques: X-ray diffraction, Raman spectroscopy (RS), Fourier-transform infrared reflection (FTIR), UV-Visible spectroscopy, Scanning electron microscopy (SEM), Transmission electron microscopy, Atomic force microscopy (AFM) and Differential Scanning Calorimetry (DSC).

UNIT V: Materials and Devices: Characteristics of shape memory alloys, Magnetostrictive, Optoelectronic, Piezoelectric, Metamaterials, Electro-rheological and Magneto-rheological materials and Composite materials.

Devices based on smart materials: Sensors & Actuators, MEMS and intelligent devices, Future scope of the smart materials.

Textbooks:

1. Encyclopaedia of Smart Materials- Mel Schwartz, John Wiley & Sons, Inc.2002
2. Smart Materials and Structures - M. V. Gandhi and B.S. Thompson, Chapman and Hall, 1992

References:

1. Smart Materials and Technologies- M. Addington and D. L. Schodek, , Elsevier, 2005.
2. Characterization and Application of smart Materials -R. Rai, Synthesis, , Nova Science, 2011.
3. Electroceramics: Materials, Properties, Applications -A.J. Moulson and J.M. Herbert, 2nd Edn., John Wiley & Sons, 2003.
4. Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic 1. Emission Sensors, Materials and Amplifiers, G. Gautschi, Springer, 2002.
5. Optical Metamaterials: Fundamentals and Applications -W. Cai and V. Shalaev, springer,2010.
6. Smart Materials and Structures - P. L Reece, New Research, Nova Science, 2007

NPTEL courses links

<https://nptel.ac.in/courses/112/104/112104173/>

<https://nptel.ac.in/courses/112/104/112104251/>

https://nptel.ac.in/content/storage2/courses/112104173/Mod_1_smart_mat_lec



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech IV-I Sem **L T P C**
3 0 0 3
(20A51703) GREEN CHEMISTRY AND CATALYSIS FOR SUSTAINABLE
ENVIRONMENT (OPEN ELECTIVE-IV)

Course Objectives:

- Learn an interdisciplinary approach to the scientific and societal issues arising from industrial chemical production, including the facets of chemistry and environmental health sciences that can be integrated to promote green chemistry and the redesign of chemicals, industrial processes and products.
- Understand the use of alternatives assessments that combine chemical, environmental health, regulatory, and business considerations to develop safer products.

Course Outcomes:

- Recognize and acquire green chemistry concepts and apply these ideas to develop respect for the inter connectedness of our world and an ethic of environmental care and sustainability.

UNIT I: PRINCIPLES AND CONCEPTS OF GREEN CHEMISTRY

Introduction, Green chemistry Principles, sustainable development and green chemistry, atom economy, atom economic: Rearrangement and addition reactions and un-economic reactions: Substitution, elimination and Wittig reactions, Reducing Toxicity. Waste - problems and Prevention: Design for degradation, Polymer recycling.

UNIT II: CATALYSIS AND GREEN CHEMISTRY

Introduction to catalysis, Heterogeneous catalysts: Basics of Heterogeneous Catalysis, Zeolites and the Bulk Chemical Industry, Heterogeneous Catalysis in the Fine Chemical and Pharmaceutical Industries, Catalytic Converters, Homogeneous catalysis: Transition Metal Catalysts with Phosphine Ligands, Greener Lewis Acids, Asymmetric Catalysis, Heterogenising the Homogenous catalysts, Phase transfer catalysis: Hazard Reduction, C–C Bond Formation, Oxidation Using Hydrogen Peroxide, Bio-catalysis and photo-catalysis with examples.

UNIT III: ORGANIC SOLVENTS: ENVIRONMENTALLY BENIGN SOLUTIONS

Organic solvents and volatile organic compounds, solvent free systems, supercritical fluids: Super critical carbon dioxide, super critical water and water as a reaction solvent: water-based coatings, Ionic liquids as catalyst and solvent

UNIT IV: EMERGING GREENER TECHNOLOGIES AND ALTERNATIVE ENERGY SOURCES

Biomass as renewable resource, Energy: Fossil Fuels, Energy from Biomass, Solar Power, Other Forms of Renewable Energy, Fuel Cells, Chemicals from Renewable feedstocks: Chemicals from Renewable Feedstocks: Chemicals from Fatty Acids, Polymers from Renewable Resources, Some Other Chemicals from Natural Resources, Alternative Economies: The Syngas Economy, The Biorefinery, Design for energy efficiency: Photochemical Reactions: Advantages of and Challenges Faced by Photochemical Processes, Examples of Photochemical Reactions, Chemistry Using Microwaves: Microwave Heating, Microwave-assisted Reactions, Sonochemistry: Sonochemistry and Green Chemistry, Electrochemical Synthesis: Examples of Electrochemical Synthesis. Industrial applications of alternative environmentally benign catalytic systems for carrying out the important reactions such as selective oxidation, reduction and C-C bond formations (specific reactions).

UNIT V: GREEN PROCESSES FOR GREEN NANOSCIENCE

Introduction and traditional methods in the nanomaterials synthesis, Translating green chemistry principles for practicing Green Nanoscience. Green Synthesis of Nanophase Inorganic Materials and Metal Oxide Nanoparticles: Hydrothermal Synthesis, Reflux Synthesis, Microwave-Assisted Synthesis, Other methods for Green synthesis of metal and metal oxide nanoparticles, Green chemistry applications of Inorganic nanomaterials

Textbooks:

1. M. Lancaster, Green Chemistry an introductory text, Royal Society of Chemistry, 2002.
2. Paul T. Anastas and John C. Warner, Green Chemistry Theory and Practice, 4th Edition, Oxford



University Press, USA

References:

1. Green Chemistry for Environmental Sustainability, First Edition, Sanjay K. Sharma and Ackmez Mudhoo, CRC Press, 2010.
2. Edited by Alvise Perosa and Maurizio Selva , Hand Book of Green chemistry Volume 8:Green Nanoscience, wiley-VCH, 2013.



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (HSMC)– IV-I Sem
(20A52704) GENDER STUDIES
(OPEN ELECTIVE-IV)

L T P C
3 0 0 3

UNIT I: Women and Society: Understanding Sex- Gender, Gender shaping Institutions, Theories of Gender construction Understanding Sexism and Androcentrism, Understanding Patriarchy and Theories of Patriarchy, Private and Public dichotomy, Sexual Division of Work, Patriarchy practices in different institutions

UNIT II: Feminist Theory: Rise of Feminism, Introduction to various stands of Feminism Liberal Feminism, Radical Feminism, Marxist Feminism, Socialist Feminism, Cultural Feminism, Eco-Feminism, Post Colonial Feminism, Post Modern Feminism. Waves of Feminism.

UNIT III: Women's Movement: The socio-economic conditions of women during the age of Industrial revolution the Call for Women's Rights 1848, Women's rights movement 1848-1920, Historical Developments of Social Reform Movements in India

UNIT IV: Gender Roles and Psychology of Sex: Difference Conceptualization of gender roles and gender role attitudes, Gender: Aggression, Achievement, Communication, Friendship and Romantic Relationships Sex Differences in Mental Health Trauma relating to Rape, Taboo, Childhood Sexual Abuse, Domestic Violence, Sexual Harassment at Work Place, Educational Institutions, Eve Teasing etc.

UNIT V

Gender and Representation: Gender and Mass Media- Print Media, Gender and Mass Media- Electronic Media, Gender and Films, Advertisements, Mega Serials, Stereotyping and breaking the norms of women's roles Women's Representation in Literary Texts.

Suggested reading:

1. Basabi Chakrabarti, Women's Studies: Various Aspects. Urbi Prakashani 2014
2. Arvind Narrain. Queer: Despised Sexuality Law and Social Change. Book for Change. 2005
3. Chandra Talpade Mohanty, Feminism without Borders: Decolonizing Theory Practicing Solidarity. Duke University Press.
4. Flavia Agnes. Law and Gender Inequality: The Politics of Women's Rights in India. Oxford University Press, 2001
5. Sonia Bathla, Women, Democracy and the Media: Cultural and Political Representations in the Indian Press, Sage, New Delhi, 1998.



HONORS



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)

L T P C
3 1 0 4

(20A03H01) MECHANICS AND MANUFACTURING OF COMPOSITE MATERIALS

Course Objectives:

- Understand the properties of composite materials.
- Familiarize the manufacturing methods for composites.
- Teach the practical requirements associated with joining and manufacturing

Course Outcomes:

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

- Design and manufacture composite materials for various applications.
- Conduct mechanical testing of composite structures and analyse failure modes.
- Synthesize structures for environmental effects.
- Analyse economic aspects of using composites.

UNIT I Introduction To Composite Materials

Introduction To Composite Materials: Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites. **Applications:** Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites.

Fiber Reinforced Plastic Processing: Lay-up and curing, fabricating process, open and closed mould process, hand lay-up techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding.

UNIT II Micro & Macro Mechanics of Materials

Micro Mechanical Analysis of a Lamina:

Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli by Rule of mixture, Numerical problems.

Macro Mechanics of a Lamina: Hooke's law for different types of materials, Number of elastic constants, Two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems.

UNIT III Biaxial Strength

Biaxial Strength Theories

Maximum stress theory, Maximum strain theory, Tsai-Hill theory, Tsai, Wu tensor theory, Numerical problems.

Macro Mechanical Analysis of Laminate

Introduction, CLT, Kirchhoff hypothesis, CLT, A, B, and D matrices (Detailed derivation), Special cases of laminates, Numerical problems.

UNIT IV Metal Matrix Composite

Metal Matrix Composites: Metal Matrix Composites: Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC's and its application.

Fabrication Process For MMC's: Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques.

Study Properties Of MMC's: Physical Mechanical, Wear, machinability and Other Properties. Effect of size, shape and distribution of particulate on properties.



UNIT V Failure Theories

Micromechanics of Failure of Unidirectional Lamina, Anisotropic Strength and Failure Theories, Importance of Shear Strength, Choice of Failure Criteria, Examples.

Textbooks:

1. K.K. Chawla, Composite Materials, Springer-Verlag, New York, 1998.
2. B.T. Astrom, Manufacturing of Polymer Composites, Chapman & Hall, 1997.
3. Stuart M Lee, J. Ian Gray, Miltz, Reference Book for Composites Technology, CRC press, 1989.

Reference Books:

1. Frank L Matthews and R D Rawlings, Composite Materials: Engineering and Science, Taylor and Francis, 2006.
2. D. Hull and T.W. Clyne, Introduction to Composite Materials, Cambridge University Press, 1996.
3. M.R. Piggott, Load Bearing Fibre Composites, Pergamon press, Oxford, 1998.
4. F. Ashby and D.R.H. Jones, Engineering Materials, Pergamon press, 1999.
5. R.W. Davidge and A. Kelly, Mechanical behavior of ceramics, Cambridge university press, 1999.
6. Andrew C. Marshall, Composite Basics, Marshall Consulting. Mode of Evaluation Quiz/Assignment/ Seminar/Written Examination, 1998.

Online Learning Resources:

- <https://nptel.ac.in/courses/112104221>
- <https://nptel.ac.in/courses/112104229>
- <https://nptel.ac.in/courses/112104161>
- https://onlinecourses.nptel.ac.in/noc22_me40/preview



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME) **L T P C**
3 1 0 4

(20A03H02) APPLICATIONS OF COMPUTATIONAL FLUID DYNAMICS

Course Objectives:

- Teach the basics of the major theories, approaches and methodologies used in CFD.
- Familiar with the differential equations for flow phenomena and numerical methods for their solutions.
- Introduce explicit and implicit schemes in hyperbolic equations.
- Expose the students to solve the problems through finite volume method.
- Understand the concepts of linear fluid flow problems, steady state problems and transient problems.

Course Outcomes:

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

- Summarize the major theories, approaches and methodologies used in CFD.
- formulate finite volume method for two and three dimensional fluid flow problems.
- apply numerical models to fluid flow and heat transfer calculations

UNIT I Introduction and Solution methods

Introduction: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions, Derivation of finite difference equations.

Solution methods: Solution methods of elliptical equations — finite difference formulations, interactive solution methods, direct method with Gaussian elimination. Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

UNIT II Hyperbolic equations:

explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

UNIT III Formulations Of Incompressible Viscous Flows

Formulations Of Incompressible Viscous Flows: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.

Treatment of compressible flows: potential equation, Euler equations, Navier-stokes system of equations, flow field-dependent variation methods, boundary conditions, example problems.

UNIT IV Finite Volume Method:

Finite volume method via finite difference method, formulations for two and three-dimensional problems.

UNIT V Standard Variational Methods:

Linear fluid flow problems, steady state problems, Transient problems.

Textbooks:

1. T. J. C'hung, Computational fluid dynamics, Cambridge University press, 2002.
2. John D. Anderson, Computational Fluid Dynamics: Basics with applications, Mc Graw Hill. 2017

Reference Books:

1. Frank Choriton, Text book of fluid dynamics, CBS Publishers & distributors, 1985.
2. Suhas V. Patankar, Numerical heat transfer and fluid flow, Hema shava Publishers corporation & Mc Graw Hill, 1990.



3. Muralidaran, Computational Fluid Flow and Heat Transfer, Narosa Publications, 2003.
4. Tapan K. Sengupta, Fundamentals of Computational Fluid Dynamics, Universities Press, 2004.
5. C. Pozrikidis, Introduction to Theoretical and Computational Fluid Dynamics, Oxford University press, 2/e, 2012.

Online Learning Resources:

- <https://nptel.ac.in/courses/112107079>
- <https://www.youtube.com/watch?v=3QFT7pGx03I>
- https://www.youtube.com/watch?v=t7jS7V_6TGQ
- <https://nptel.ac.in/courses/112107080>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME) **L T P C**
3 1 0 4

(20A03H03) ADVANCED AUTOMOTIVE ELECTRONICS

Course Objectives:

- Explain the use of electronics in the automobile.
- Explain the importance of various types of sensors and actuators in automotive electronics.
- Demonstrate the various control elements in Engine Management system.
- Familiarize with Vehicle management systems
- Identify various electronic and the instrumentation systems used in automobile.

Course Outcomes:

After completion of this course the student can be able to:

- Obtain an overview of automotive components, like sensors, actuators, communication protocols and safety systems employed in today's automotive industry.
- Interface automotive sensors and actuators with microcontrollers.
- Know, the various display devices that are used in automobiles.
- Identify the elements in the engine management and vehicle management system.

UNIT I Introduction to microcomputer:

Microcomputer: Buses, memory, timing, CPU registers; Microprocessor architecture: Initialization, operation codes, program counter, branch and jump instructions, subroutine. Analog to digital converters and Digital to analog converters, sampling, polling and interrupts, digital filters, lookup table.

UNIT II Sensors and actuators:

Speed sensors, Pressure sensors: Manifold Absolute Pressure sensor, knock sensor, Temperature sensors: Coolant and Exhaust gas temperature, Exhaust Oxygen level sensor, Position sensors: Throttle position sensor, accelerator pedal position sensor and crankshaft position sensor, Air mass flow sensor. Solenoids, stepper motors and relays.

UNIT III Electronic engine management system:

Electronic engine control: Input, output and control strategies, electronic fuel control system, fuel control modes: open loop and closed loop control at various modes, EGR control, Electronic ignition systems – Spark advance correction schemes, fuel injection timing control.

UNIT IV Electronic vehicle management system:

Cruise control system, Antilock braking system, electronic suspension system, electronic steering control, traction control system, Transmission control, Safety: Airbags, collision avoiding system, low tire pressure warning system.

UNIT V Automotive instrumentation system:

Input and output signal conversion, multiplexing, fuel quantity measurement, coolant temperature and oil pressure measurement, display devices- LED, LCD, VFD and CRT, Onboard diagnostics(OBD), OBD-II, off board diagnostics.

Textbooks:

1. Understanding Automotive Electronics, William B Ribbens, Newne Butterworth-Heine 6/e, 2003.
2. Crouse W H, Automobile Electrical Equipment, McGraw Hill Book Co.Inc, Newyork, 2005.

Reference Books:

1. Bechhold "Understanding Automotive Electronics", SAE, 1998.
2. Robert Bosch "Automotive Hand Book", SAE, 5/e, 2000.
3. Tom Denton, "Automobile Electrical and Electronic Systems" 3/e, Edward Arnold, London, 2004.
4. Eric Chowanietz - 'Automotive Electronics' - SAE International USA, 1995.



Online Learning Resources:

- <https://nptel.ac.in/courses/107106088>
- <https://www.youtube.com/watch?v=BOP8qLQzhDc>
- <https://nptel.ac.in/courses/108104140>
- <https://intranet.cb.amrita.edu/sites/default/files/164-AutomotiveElectronics.pdf>
- <http://digimat.in/nptel/courses/video/108108147/L01.html>
- https://jssstuniv.in/wp-content/uploads/2020/09/M.Tech-Automotive-Electronics-_Final.pdf



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
B.Tech (ME)

L T P C
3 1 0 4

(20A03H04) APPLICATIONS OF OPTIMIZATION TECHNIQUES

Course Objectives:

- Explain principles of optimization and its need.
- Familiarization with theory of optimization methods and algorithms developed for solving various types of optimization problems.
- Understand the mathematical foundations for Genetic Algorithm, Operators.
- Know fundamental theory and concepts of neural networks, neuro – modelling, several neural network paradigms and its applications.
- Identify the application of optimization to design of machine elements.

Course Outcomes:

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

- Know the principles of optimization and its need.(L2)
- Identify optimization methods and algorithms developed for solving various types of optimization problems. (L2)
- Understand and appreciate the basic concepts of Genetic Algorithms and results of applying various genetic operators. (L3)
- Solve the concepts of Neural Networks for training and validation of neural network models. (L6)

UNIT I Introduction

Classical Optimization Techniques: Single variable optimization with and without Constraints, Multi – Variable Optimization without constraints, Multi – Variable Optimization with Constraints – Method of Lagrange Multipliers, Kuhn-Tucker Conditions.

Numerical Methods for Optimization: Interval Halving Method, Fibonacci Method, Quadratic Interpolation Method, Newton Method, Quasi Newton Method, Secant Method.

UNIT II Genetic Algorithm (GA):

Differences and Similarities between Conventional and Evolutionary Algorithms, Working Principle, Reproduction, Crossover, Mutation, Termination Criteria, Different Reproduction and Crossover Operators, GA for Constrained Optimization, Draw Backs of GA.

UNIT III Genetic Programming (GP):

Principles of Genetic Programming, Terminal Sets, Functional Sets, Differences between GA & GP, Random Population Generation, Solving Differential Equations using GP.

UNIT IV Neural networks

Introduction to Neural networks: Knowledge base information processing, General View of Knowledge Based Algorithm, Neural Information Processing, Hybrid Intelligence and Artificial Neurons.

Characteristics of Artificial Neural Networks: Single Neural Networks, Multi – Layer Neural Networks, Training of ANN – Objective, Supervise Training, Unsupervised Training, Overview of training.

UNIT V Applications of Optimization in Design and Manufacturing Systems:

Some typical applications like Optimization of Path Synthesis of a Four – bar Mechanism, Minimization of Weight of a Cantilever Beam, Optimization of Springs and Gears, General Optimization model of a Machining Process, Optimization of Arc Welding Parameters and General Procedure in Optimizing Machining Operations Sequence.



Textbooks:

1. Singiresu S. Rao, Engineering Optimization, 3/e, New Age Publishers, 2010.
2. Bart Kosko, Neural Networks and Fuzzy System, 2/e, Prentice Hall of India, 2001.
3. Goldberg D.E., Genetic algorithms in Search, Optimization, and Machine learning, 4/e, Pearson, 2009.
4. Kalyanmoy Deb, Optimization for Engineering Design: Algorithms and Examples, 2/e, PHI Learning Pvt. Ltd., 2012.

Reference Books:

1. Kalyanmoy Deb, Multi Objective Optimization using Evolutionary Algorithms, 1/e, John Wiley and Sons, 2001.
2. Jasbir S. Arora, Introduction to Optimum Design, 4/e, Academic Press, 2016.
3. Ravindran A., Engineering Optimization Methods and Applications, 2/e, John Wiley and Sons, 2006.
4. Fox R.L., Optimization Methods for Engineering Design, 1/e, Addison Wesley Publication Co., 1971.

Online Learning Resources:

- <https://nptel.ac.in/courses/111105039>
- <https://nptel.ac.in/courses/105108127>
- <https://nptel.ac.in/courses/111105100>
- <https://nptel.ac.in/courses/112105235>
- <https://nptel.ac.in/courses/106108056>
- <https://nptel.ac.in/courses/112101298>