

Gayatri Vidya Parishad College for Degree and PG Courses (A)

Department of Mechanical Engineering

Accredited by NBA and NAAC

B.Tech MECHANICAL ENGINEERING PROGRAM (R - 20)

SEMESTER VII

(IV year I Semester)

Sl. No.	Code	Category	Course Title	Hours per week			Allotment of Marks		Total Marks	Credits
				L	T	P	Internal	External		
1	2095701	PCC	Machine Design	3	0	0	30	70	100	3
2	2095702	PCC	Operation Research	3	0	0	30	70	100	3
3	2095703	PEC	Elective IV	3	0	0	30	70	100	3
4	2095704O	OEC	OEC-III	3	0	0	30	70	100	3
5	2095705O	OEC	OEC-IV	3	0	0	30	70	100	3
6	2095706	PROJECT	Mini-Project/Summer Internship	0	0	3	100	0	100	1.5
7	2095707P	PCC	CAD & CAE Lab	0	0	3	50	50	100	1.5
8	2095708P	PCC	Industrial Engineering Lab	0	0	3	50	50	100	1.5
9	2095709S	SOC	Applications in Mechanical Engineering Using scilab	1	0	2	50	50	100	2
			Total	16	0	11	400	500	900	21.5
11	2095709	PCC	Minor Course-IV	3	1	0	30	70	4	4
12	2095710	PCC	Honors Course-IV	3	1	0	30	70	4	4

SEMESTER VIII

(IV year II Semester)

Sl. No.	Code	Category	Course Title	Hours per week			Allotment of Marks		Total Marks	Credits
				L	T	P	Internal	External		
1	2095801	PROJECT	PROJECT	0	0	0	50	50	100	10
2	2095802	MOOC	MOOCS	0	0	3	50	50	100	1.5
			Total	0	0	3	100	100	200	11.5

BSC : BASIC SCIENCE COURSE

PCC : PROFESSIONAL CORE COURSE

ESC : ENGINEERING SCIENCE COURSE

PEC : PROFESSIONAL ELECTIVE COURSE

OEC : OPEN ELECTIVE COURSE

MC : MANDATORY COURSE

HSSC : HUMANITIES AND SOCIAL SCIENCES COURSE

SOC : SKILL ORIENTED COURSE

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PROFESSIONAL ELECTIVE COURSES

Elective-I:

2095504A Mechatronics
2095504B Rapid Prototyping
2095504C Work Study
2095504D Power Plant Engineering

Elective-II:

2095505A Unconventional Machining Process
2095505B Industrial Tribology
2095505C Total Quality Management
2095506D Automobile Engineering

Elective-III:

2095605A Project Management
2095605B Supply Chain Management
2095605C Tool Design
2095605D Finite Element Analysis

Elective-IV:

2095703A Robotics
2095703B Statistical Quality Control
2095703C Renewable Energy Technologies
2095703D Heating Ventilation Air- conditioning
and Refrigeration

OPEN ELECTIVE COURSES

Open Elective Course-I	: 2095506O	Basic Mechanical Engineering
Open Elective Course-II	: 2095606O	Industrial Engineering
Open Elective Course-III	: 2095704O	Project Management
Open Elective Course-IV	: 2095705O	Non-Conventional Energy Sources

SKILL ORIENTED COURSES

Skill Oriented Course-I	: 2095308S	Maintenance and Safety Engineering
Skill Oriented Course –II	: 2095407S	Computer Aided Drafting
Skill Oriented Course -III	: 2095507S	Python Programming
Skill Oriented Course -IV	: 2095607S	Internet Of Things
Skill Oriented Course-V	: 2095709S	Matlab Applications in Mechanical Engineering

Course code	Title of the course	Contact periods for delivering the course	Credits
2095701	MACHINE DESIGN	L T P 3 0 0	Credits: 3

Course Objectives:

1	To design and analyze stresses and strains in spur gears and helical gears
2	To formulate and design Components of an IC engines
3	To Understand the design of mechanical components like clutches, breaks
4	To design and select the suitable bearing
5	To design wire ropes and understand the design knowledge on chain drives.

COURSE OUTCOMES:

The student will be able to

CO 1	Design and analyze different spur gear systems under variable loading conditions.
CO 2	Determine various stresses and design different components of IC Engines
CO 3	Understand the design of clutches, brakes and apply it to various working conditions
CO 4	Select appropriate bearing and calculate bearing life.
CO 5	Design wire ropes and chain drives for the given working conditions.

SYLLABUS:

Unit 1: Classification, Terminology, Gear manufacturing methods, Gear materials. Design of Spur gears Tooth failure. Face width and beam strength. Lewis equation. Design for dynamic and wear loads. Design of Helical gears – virtual number of teeth, Force analysis, Beam strength, wear strength.
Unit 2: Design of IC Engine parts: Design of cylinder – Cylinder, Cylinder liner, Cylinder Head, Studs; Design of piston – Head, Cup, piston rings, Skirt; Design of Connecting rod – Cross section, big and Small end bearings, bolts; Design of crank shaft for single cylinder engine.

Unit 3:
Friction clutches: Classification of clutches, Torque carrying capacity - single plate and multi-plate clutches. Design considerations. Energy considerations and Temperature rise, friction materials. Brakes: Classification of brakes, Energy equations. Band brake (Simple band brake) and block brakes (short shoe block brake). Internal expanding shoe brakes, self-locking of brakes.
Unit 4:
Sliding contact bearings. Types of journal bearings, Lubrication modes – hydrostatic and hydrodynamic lubrication, Temperature effect on viscosity. Bearing modulus. McKee equations, Design procedure of journal bearing Rolling Contact bearings: Classification. Static and dynamic load capacity. Equivalent bearing load. Load-life relationships. Selection of bearings from manufacturer's catalogue.
Unit 5:
Wire ropes: Wire rope construction and classification. Stresses in wire ropes. Design of wire ropes (simple problems) Chain Drives: Classification, Terminology, Geometrical relationships, power rating of roller chains, design procedure for chain drives (simple problems).

Note: Design Data Books are to be provided during Examination.

Text Books:

1. Design of Machine Elements by V.B.Bhandari, TMH Publishing Co. Ltd., New Delhi, 4th edition
2. Mechanical engineering Design by Shigley's, Richard G. Budynas, J. Keith Nisbett. McGraw-Hill Education, 10th edition

References:

1. Machine Design by R.K.Jain, Khanna Publications, 4th edition
2. Design of Machine Elements by M. F. Spotts, T. E. Shoup, L. E. Hornberger, A P Harsha, Pearson Publishers, 5th edition.
3. Machine Design by Dr.N.C.Pandya and Dr.C.S.Shaw, Charotar publications, 21st edition.
4. A Textbook of Machine Design by R.S.Khurmi and J.K.Gupta, S.Chand Publishers, 5th edition.

Course code	Title of the course	Contact periods for delivering the course	Credits
2095702	OPERATIONS RESEARCH	L T P 3 0 0	Credits: 3

Course Objectives:

1. Formulate a real world problem as a mathematical programming model.
2. Provide knowledge of optimization techniques and approaches.
3. Understand and study inventory problems.
4. Know the network models.
5. Put on knowledge in solving replacement problems and different queuing models

Course Outcomes:

- CO 1: Learned to translate a real-world problem into a mathematical formulation.
CO 2: Formulate and Solve Transportation, Assignment and sequencing problems.
CO 3: Resolve inventory problems.
CO 4: Able to solve maximum flow and shortest path problems.
CO 5: Capable to solve replacement problems and analyze queuing models.

Unit I:

Introduction: Definitions of Operations Research; Phases of Operations Research; Types of Operations Research models; applications, merits and demerits of Operations Research.

Allocation: Linear Programming problem formulation; Basic assumptions; Graphical solution; Simplex method; Artificial variable technique; Two phase method; Big M method; Duality principle; Primal and Dual relation.

Unit II:

Transportation: Formulation; Solution methods; Unbalanced transportation problems - North west corner rule; Least cost entry method; Vogel's approximation method; Optimal solution; degeneracy.

Assignment: Formulation; Variations in Assignment problem; Travelling salesman problem.

Sequencing: Sequencing of - n jobs through two machines; n jobs through three machines; n jobs through m machines; 2 jobs through m machines.

Unit III:

Inventory Control: Introduction; Types of Inventory; Inventory costs; Deterministic models - Economic order quantity (EOQ) and Economic Production Quantity (EPQ) with and without

shortages; Quantity discounts; P system; Q system; Inventory control Techniques.

Unit IV:

Network Analysis: Network definitions; Time estimates in network analysis; Labeling using Fulkerson's rule; Forward pass computations; Backward pass computations; Project management using Critical Path Method(CPM) and Programme Evaluation and Review Technique(PERT).

Unit V:

Replacement: Introduction, Replacement of items that deteriorate with time - Value of money unchanging and changing, Replacement of items that fail completely.

Queuing models: Introduction; Single channel poisson arrivals; Exponential service times; unrestricted queue with infinite population and finite population models; Multi channel poisson arrivals; Exponential service times with infinite population and restricted queue.

Text Books:

1. Operations Research- An Introduction, TAHA , Prentice Hall, 2009.
2. Introduction to Operations Research , F.S. Hiller, G.J. Liberman, B. Nag and P. Basu ", Mc Graw Hill Education(India), 2012.
3. Operations Research , S.D.Sharma, Kedarnadh Ramnadh & Co.,2017

Reference Books:

1. Operations Research, R. Pannerselvam PHI..
2. Operations Research, Richard Bronson, Schaum's Series, Mc Graw Hill
3. Operations Research- Theory and Practice, N.V.S.Raju, BS publications.
4. Operations Research, V.K. Kapoor , Sultan Chand & Sons.

Course code	Title of the Course	Contact			Allotment of Marks		Credits
		L	T	P	Int	Ext	
2095703A	ROBOTICS						3
		3	0	0	30	70	

SYLLABUS:

UNIT-I

Introduction: Background- Historical Development-Robot Arm kinematics and Dynamics-Manipulator Trajectory Planning and Motion Control-Robot Sensing- Robot Programming Language- Machine Intelligence.

UNIT-II

Robot Arm kinematics: Introduction – The Direct Kinematics Problem-The Inverse Kinematics Solution.

UNIT-III

Robot Arm Dynamics: Introduction – Lagrange-Euler Formulation- Newton-Euler Formulation - Generalized D'Alemberts Equations of Motion.

UNIT-IV

Planning of Manipulator Trajectories: Introduction-General Considerations on Trajectory Planning- Joint Interpolated Trajectories- Planning of Manipulator Cartesian Path Trajectories.

Control of Robot Manipulators: Introduction – Control of the Puma Robot arm- Computed Torque Technique- near Minimum Time Control- Variable Structure Control- Nonlinear Decoupled Feedback Control- Resolved Motion Control- Adaptive Control.

UNIT-V

Sensing: Introduction-Range Sensing-Proximity Sensing- Touch Sensors- Force and Torque Sensing.

Low-Level Vision: Introduction –Image acquisition- Illumination Techniques- Imaging Geometry- Some Basic Relationship between Pixels – Pre-processing.

Robot Programming Languages: Introduction- Characteristics of Robot Level Languages- Characteristics of Task Level Languages.

Text Book: 1. Robotics by K.S. Fu, R.C. Gonzalez and C.S.G Le, McGraw- Hill International Editions 1987.

Reference Books:

1. Industrial Robotics by M.P. Groover, Mitchell Weiss, Roger N. Nagel and N.G. Odrey, McGraw- Hill International Editions 1986.

2. Robot Analysis- The Mechanics of Serial and Parallel Manipulators By Lung-Wen Tsai, John Wiley and Sons, Inc

Course code	Title of the Course	Contact Hours/week			Allotment of Marks		Credits
		L	T	P	Int	Ext	
2095703B	Statistical Quality Control	3	0	0	30	70	3

Note: L – Lecture periods; T- Tutorial periods; P- Practical periods

COURSE OBJECTIVES:

- CO-1 Apply the concepts of statistical quality control such as off-line and on-line quality control, Quality management philosophies, quality costs, Taguchi's loss function.
- CO-2 Produce and analyze the control charts for variables to evaluate the process performance.
- CO-3 Prepare and analyze the control charts for attributes to conclude about the process control.
- CO-4 Analyze and make conclusions about the process capability.
- CO-5 Design, apply and analyze the sampling plans to judge the quality of the products.

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

CO1	Understand quality , TQM philosophies and their importance
CO2	Know how to evaluate process quality performance by using control charts under variables consideration.
CO3	Know how to evaluate process quality performance by using control charts under attributes consideration.
CO4	Understand the procedure to carryout process capability analysis
CO5	Know about acceptance sampling and design of single, double, multiple and sequential sampling plans

UNIT-I:

Introduction to quality - definitions of quality, dimensions of quality, phases of quality, quality control, costs of quality; Concept of Total quality management: TQM Philosophies - Deming's philosophy, Taguchi's philosophy ; concept of Taguchi's loss function.(Simple problems)

UNIT-II:

Control charts of variables; Concept of variability : types of variability ; Introduction to control charts - objectives and uses of control charts; control charts for variables - \bar{X} - R and Sigma control charts, control chart patterns: Average run length (ARL) and Average time to signal (ATS) - Simple problems on control charts for variables.

UNIT-III

Introduction to Control charts for attributes; Area of application attribute control charts; p - chart, np - chart, c - chart, u - chart, demerit control chart - Simple problems on control charts for attributes.

UNIT-IV

Process capability analysis: Process capability analysis using frequency distribution; Process capability analysis using control charts; Process capability analysis using process capability ratios - C_p and C_{pk} ; Process capability ratios for nominal the better type, smaller the better type and larger the better type product specifications. (Simple problems only).

UNIT-V

Introduction Acceptance sampling: Sampling methods ; Single, double, multiple and sequential sampling plans; OC- curve ; AOQ, AOQL;ATI; Design of single and sequential sampling plans. (Simple problems only)

Text Book:

1. Statistical Quality Control, Mahajan, Dhanpatrai & Co
2. Statistical Quality Control, Eugene Grant, Richard Leavenworth, 7th edition, McGraw Hill Education

Reference Books:

1. Fundamentals of Quality Control and Improvement, Amitava Mitra, 4th edition, John Wiley & Sons
2. Introduction to statistical quality control by Douglas C. Montgomery, 6th edition, John Wiley & Sons.
3. Statistical Quality Control & Quality Management by R.C. Gupta

Note: Statistical tables are permitted during Examination.

Course code	Title of the Course	Contact Hours/week			Allotment of Marks		Credits
		L	T	P	Int	Ext	
2095703C	RENEWABLE ENERGY TECHNOLOGIES	3	0	0	30	70	3

COURSE OBJECTIVE:

- 1) Students should have an exposure to renewable energy sources as it is one of the Emerging areas

COURSE OUTCOMES:

- 1) Realise the importance and usage of alternate energy sources instead of conventional energy sources
- 2) Acquire and apply the principles of solar energy its measurements on various solar energy collectors and accrue the knowledge about energy storage and applications.
- 3) Identify and analyse wind energy characteristics and types of wind mills.
- 4) Understand the concept of bio energy conversion and their applications.
- 5) Understand the concepts and applications of geothermal, ocean, tidal, wave energies and MHD, thermoelectric power generation and fuel cells.

SYLLABUS:

UNIT I

Energy Scenario: Indian energy scenario in various sectors, domestic, industrial, commercial, agriculture, transportation and others, Present conventional energy status, Present renewable energy status, Potential of various renewable energy sources, Global energy status, Per capita energy consumption in various countries

UNIT II

PRINCIPLES OF SOLAR RADIATION: Physics of the sun, the solar constant, Extraterrestrial and terrestrial solar radiation, Solar radiation on tilted surface-no derivations, Instruments for measuring solar radiation and sun shine, Solar radiation data.

SOLAR ENERGY COLLECTION AND ITS APPLICATIONS: Flat plate and concentrating collectors, Classification of concentrating collectors, Advanced collectors. Solar energy storage and applications: Different methods, Sensible, Latent heat and stratified storage, Solar ponds. Solar Applications- Solar heating and cooling technique, Solar distillation and drying, Photovoltaic energy conversion.

UNIT III

Wind Energy: Wind data and energy estimation – Betz limit - Site selection for wind farms – characteristics Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT IV

Bio-Energy: Bio resources – Biomass direct combustion – thermo-chemical conversion - biochemical conversion mechanical conversion - Biomass gasifier: Types of biomass gasifiers, applications, Biogas plants: Types of biogas Digesters: KVIC, Chinese, Taiwanese and hybrid models-construction, Biodiesel production, Ethanol production - Applications.

UNIT V

Ocean and Geothermal Energy: Small hydro, Tidal energy, Wave energy: Open and closed OTEC Cycles, Limitations Geothermal energy: Geothermal energy sources, Types of geothermal power plants, Applications.

Additional Alternate Energy Sources: MHD Power Generation: Open cycle and closed cycle systems, advantages. Thermoelectric power generator, Thermoelectric materials. Fuel cells- classification, advantages and disadvantages.

Text Book:

1. G.D. Rai ,Non-Conventional Energy Sources, ,Khanna Publishers 5th Edition.

References:

1. Renewable Energy Sources by Twidell& Weir
2. Solar Power Engineering by B.S Magal, Frank Kreith and J.F Kreith.
3. Principles of Solar Energy by Frank Krieth and John F Kreider.
4. Non-Conventional Energy by Ashok V Desai, Wiley Eastern Publications.
5. Non-Conventional Energy Systems by K Mittal , Wheeler.
6. Renewable Energy Technologies by Ramesh and Kumar, Narosa Publications

HEATING, VENTILATION, AIR CONDITIONING AND REFRIGERATION

Course code	Periods			Total contact hours/ per week	Sessional Marks	Exam Marks	Total Marks	Credits
	L	T	P					
2095703D	3	1	0	4	30	70	100	3

COURSE OBJECTIVES:

1. To understand the fundamentals of HVAC, classification of Air conditioning systems, Air conditioning properties and Heat load calculations.
2. To understand the concepts on ventilation, filtration, air distribution, Refrigeration and its appliances, properties of Refrigerants and thermal insulation.
3. To understand the calculations involved in pipe sizing, duct design and ESP.

COURSE OUTCOMES:

Students will able to

1. Explain the significance of HVAC, distinguish between various Air-conditioning systems.
2. Perform the heat load calculations and utilization of ISHRAE/ASHRAE standards.
3. Explain the significance of ventilation, filtration process, indoor and outdoor design conditions, IAQ and air distribution.
4. Describe the working of Refrigeration cycle, its applications, and various refrigerants and their properties.
5. Estimate the pipe sizes for refrigeration, chillers, pumps head calculation and designing of ducts, air outlets.

SYLLABUS:

UNIT I

Introduction to HVAC: Fundamentals of HVAC, Refrigeration Cycle, Basic Components of airconditioners (Filters, Air outlets - Grills , Registers, Diffusers, Fans and blowers).

Air-conditioning systems: Working of - windows AC, splits AC , central air conditioning system -ducts AC, packaged AC, Chilled water systems, Components of chilled water systems - Chillers, Fan coil units, PICV valves, Primary & Secondary pumps, A brief about district cooling systems - Plate heat exchangers , AHU, FAHU's, VRF/VRV systems, heat pumps models.

UNIT II

Heat load calculations: Study Of Psychrometric analysis, Relative Humidity, Humidity Ratio, Processes- Heating, Cooling, Cooling and Dehumidification, Heating and Humidification.

Orientation of Building, U Factor for- wall, glass, Roof & Partition; Calculation of equivalent temperature, ASHRAE / ISHRAE standards, ADP & Dehumidification CFM.(Simple Problems only)

UNIT III

Ventilation and Infiltration: Fundamental Concepts -Thermal comfort, Indoor air quality (IAQ), Ventilation for cooling, Air distribution,(Simple Problems)

Thermal Insulation: Selection of Insulating materials, Types of Insulating Materials

UNIT IV

Refrigeration: Introduction, Working principle- Vapor Absorption Refrigeration, Vapor Compression Refrigeration (VCR), Working of Appliances - Refrigerators, VISI coolers, Cold Rooms, deep freezers, Chest coolers, Ice cube machines, Milk chillers.

Refrigerants: Different types of Refrigerants, Properties, Nomenclature.

UNIT V

Pipe Sizing: Basic concepts - Refrigerant pipe sizing, chilled water pipe sizing, Pump head Calculation (Formulae only)

Requirement for -Selection of Fan/Blower, Duct design and External Static Pressure(ESP) calculation (only formulae and simple problems) , Air outlet design and selection.

**Note: Psychrometric charts are allowed in the external examination.
ASHRAE/ISHRAE standard books are allowed.**

Text Books:

1. Basic Refrigeration and Air Conditioning , PN Ananthanarayanan, Tata McGraw Hill
2. Arora R.C., Refrigeration and Air conditioning, PHI, India.

References:

1. Refrigeration and Air conditioning, Manohar Prasad, Wiley Eastern Limited, 1983.
2. ISHRAE Handbook.
3. Principle of Refrigeration, Dossat Ray J., Pearson, India.

Course code	Title of the Course	Contact Hours/week			Allotment of Marks		Credits
		L	T	P	Int	Ext	
20957040	PROJECT MANAGEMENT	3	0	0	30	70	3

COURSE OBJECTIVES:

The main objective of the course 'Project Management' is to impart basic knowledge on various aspects related to Project Management for the students who are pursuing B.Tech degree in Mechanical Engineering and enable them to understand the basic aspects while executing projects in an industry.

COURSE OUTCOMES: At the end of the course, the students will be able to

- CO-1: Know the concept of project management and classification of projects
- CO-2: Understand the various steps involved in project identification and formulation
- CO-3: Know various project management techniques
- CO-4: Identify tasks that are necessary for project completion using critical path method
- CO-5: Understand probabilistic projects and able to calculate the time estimates

SYLLABUS:

UNIT - I: Introduction to Project Management

Introduction to Project Management (PM) – Definition of project- project management - objectives of PM - Importance of PM – Project characteristics – Project performance dimensions - Project life cycle – S-curve, J-curve ; Traits of a project manager ; Benefits of PM approach ; Classification of projects.

UNIT –II: Project Identification and Formulation

Project identification and Formulation – Steps involved in project formulation - Pre-feasibility Studies / Opportunity Studies - Feasibility Study - Economic and Market Analysis – Technical Analysis – Market Analysis - Financial Analysis: Pay-back period; Return on Investment; Net Present Value; Profitability Index/Benefit Cost Ratio; Internal Rate of Return (These topics are limited to definitions and no problems); Economic Benefits - Project Risk and Uncertainty; Detailed project report and its components.

UNIT –III: Project Management Techniques

Introduction to project management techniques – Classification of project management techniques, bar charts, Gantt charts, mile stone charts – procedures – advantages, limitations, simple problems on bar charts, Gantt charts, mile stone charts.

UNIT - IV: Project Network Analysis – I

Introduction to the Critical Path method, Application of CPM techniques, Network Diagram Representation-activities, events, sequencing, Rules for drawing Network Diagram, Time estimates and critical path in network analysis Forward pass computations for earliest event time, Backward pass computations for latest allowable time. Types of floats, Determination of floats and slack times, simple problems on Critical path method.

UNIT - V: Project Network Analysis – II

Introduction to program Evaluation and Review Technique (PERT) analysis, The optimistic time, the most likely time, The pessimistic time Expected time, formulas for calculations estimated time, Standard deviation for the project, Standard normal variate (Z) Standard deviation for each on critical path activity, Uses of PERT/CPE for Management, Application Areas of Pert/ CPM Techniques, Disadvantages of Network techniques, Simple problems on PERT.

TEXT BOOK:

1. Project Management by PRADEEP PAI, Pearson Education India, 1st Edition.

REFERENCE BOOKS:

1. Project Management: A Systems Approach to Planning, Scheduling, and Controlling, Harold Kerzner, Wiley Publication, 12th edition
2. PERT and CPM Principles and Applications, L.S.Srinath, East-West Press Pvt. Ltd, 3rd edition
3. Operations Research by S.D.Sharma, Kedar Nath Ram Nath , 15th edition

Course code	Title of the Course	Contact Hours/week			Allotment of Marks		Credits
		L	T	P	Int	Ext	
20956040	NON CONVENTIONAL ENERGY SOURCES	3	0	0	30	70	3

COURSE OBJECTIVE:

- 1) Students will have an exposure to renewable energy sources as it is one of the Emerging areas
- 2) Students will have an insight into solar, wind, biomass and their applications
- 3) Alternate energy sources like geothermal, ocean will be elucidated along with direct energy conversion.

COURSE OUTCOMES:

- 1) Realise the importance and usage of alternate energy sources.
- 2) Acquire and apply the principles on various solar energy collectors and accrue the knowledge about energy storage and applications.
- 3) Identify and analyse wind energy characteristics and types of wind mills.
- 4) Explore the usage of bio energy, its conversion and its applications.
- 5) Understand the concepts of geothermal, ocean, tidal and wave energies.

SYLLABUS:

UNIT I

Energy Scenario: Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others, Present conventional energy status, Present renewable energy status Potential of various renewable energy sources, Global energy status, Per capita energy consumption in various countries.

UNIT II

Solar Energy: Solar radiation: Measurements of solar radiation and sunshine, Solar thermal collectors: Flat plate and concentrating collectors, Solar thermal applications, Solar thermal energy storage – Fundamentals of solar photo voltaic conversion: Solar cells, Solar PV Systems, Solar PV applications.

UNIT III

Wind Energy: Wind data and energy estimation, Betz limit-no derivation, Site selection for wind farms, characteristics Horizontal axis wind turbine, components, Vertical axis wind turbine, Wind turbine generators and its performance, Hybrid systems, Environmental issues, Applications.

UNIT IV

Bio-Energy: Bio resources, Biomass direct combustion, thermo-chemical conversion, biochemical conversion mechanical conversion, Biomass gasifier: Types of biomass gasifiers, Biogas plants: Digesters, Biodiesel production, Ethanol production, Applications.

UNIT V

Ocean and Geothermal Energy: Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

Text Books:

1. Non-Conventional Energy Sources, G.D. Rai, Khanna Publishers, 5th edition, 2011
2. Renewable Energy Resources, John Twidell, Tony Weir, and Anthony D. Weir, Taylor & Francis, 2006

References:

1. Solar Energy: Principles of Thermal Collection and Storage, S.P. Sukhatme, Tata McGraw Hill, 2009
2. Non-Conventional Energy Resources, G.S. Sawhney, PHI Pvt. Ltd. 2012
3. Non-Conventional Energy Resources, BH Khan, 3rd Edition, McGraw Hill Education, 2017.
4. Solar Energy – Fundamentals Design, Modelling and applications, G.N. Tiwari, Alpha Science, 2015.

Course code	Title of the Course	Contact Hours/week			Allotment of Marks		Credits
		L	T	P	Int	Ext	
2095707P	CAD & CAE LAB	-	-	3	50	50	1.5

COURSE OBJECTIVES:

1. To impart the fundamental knowledge on using modelling tool like CATIA for engineering design and drafting.
2. To impart the fundamental knowledge on using analytical tool like ANSYS for engineering design and analysis.
3. To know various fields of engineering where these tools can be effectively used to improve the output of a product.

COURSE OUTCOMES:

The students are able to

1. Model the 3D and assembly drawings of various industrial components according to standards and can generate various views and bill of materials.
2. Perform the structural, modal and harmonic analysis on the various components using a FEA package.
3. Perform the thermal analysis on the various components using a FEA package

List of Experiments

1.	Modelling of 3D Part using CATIA
2.	Modelling of 3D Part using CATIA
3.	Assembly drawing of Knuckle Joint using CATIA
4.	Assembly drawing of Oldham Coupling using CATIA
5.	Assembly drawing of Universal Coupling using CATIA
6.	Generation of various views and Bill of materials using CATIA
7.	Static analysis for a structure using FEA Package
8.	Model analysis for a simple structure using FEA Package
9.	Harmonic analysis for a simple structure using FEA Package
10.	Thermal analysis using FEA Package for different structures under steady state thermal analysis condition
11.	Transient structural analysis using FEA Package for simple structures
12.	Transient thermal analysis using FEA Package for simple structures

Course code	Title of the Course	Contact Hours/week			Allotment of Marks		Credits
		L	T	P	Int	Ext	
2095708P	INDUSTRIAL ENGINEERING LAB	0	0	3	50	50	1.5

Course Outcomes:

CO1	The student will be capable of measuring his skill and dexterity of his wrist and figures.
CO2	The student is capable of drawing control charts for variables.
CO3	The student is capable of drawing OC curves for a specific production process.

LIST OF EXPERIMENTS

1. To show that sample means from a Normal universe follow a Normal Distribution.
2. To show that sample means from a Non- Normal universe follow a Normal Distribution.
3. To draw p – chart for fraction defective of constant sample size and to check the control of the process for the given set of plastic balls.
4. To draw p – chart for fraction defective of variable sample size and to check the control of the process for the given set of plastic balls.
5. To draw multiple activity chart (man-machine chart) for the activity of toasting four slices of bread in two electric toasters.
6. To draw the two handed process charts and to compare the times for bolt and washers assembly of present and improved methods.
7. To conduct time study of the bulb holder assembly operation of the existing method.
8. To draw flow process charts on activities in Workshop/ Laboratory/Office.
9. To draw \bar{X} and R – Chart and determine the process capability from the measurements of a given set of pins.
10. To draw the C– chart for a given set of metal disc and to check the control of the process by taking each disc with 10 holes as one unit.

11. To plot O.C curve for a single sampling attributes plan for $n = 20$, $C = 0, 1 \text{ \& } 2$ and to compare the actual O.C curve with theoretical O.C curve.

12. (a) To study the difference in time required to pick up and insert pins in holes of PIN BOARDS under different conditions & to find the standard time of the PIN BOARD assembly for the given configuration.

(b) To draw SIMO chart for the PIN BOARD assembly by using THERBLIGS.

Course code	Title of the course	Contact periods for delivering the course	Credits
2095701	Applications in Mechanical Engineering Using scilab	L T P 1 0 2	Credits: 2

Course Objectives:

- To familiarize students with the Matlab working environment and introduce them to basic commands
- To develop basic Matlab programming skills

Course Outcomes:

Students will be able to:

1. Execute basic commands in a Matlab working environment
2. Write, compile and execute programmes to solve simple mathematical problems.

Course Content:

1. Introduction and basics operations in Matlab
 - a. Exercise Set-1
 - b. Exercise Set-2
 - c. Exercise Set-3
 - d. Exercise Set-4
2. Functions and their Solutions using Numerical Methods
 - a. Exercise Set-1
 - b. Exercise Set-2
 - c. Exercise Set-3
3. Simple Plotting Commands
 - a. Exercise Set-1
 - b. Exercise Set-2
 - c. Exercise Set-3
4. Calculus – Differential / Integral
 - a. Exercise Set-1
 - b. Exercise Set-2
 - c. Exercise Set-3
 - d. Exercise Set-4
 - e. Exercise Set-5
5. Differential Equations and their solutions
6. Simple Programming in Matlab

EXERCISES

I. Parts of Matlab work environment; starting and ending a matlab session; basic commands; variables & expressions– hierarchy of precedence operations; floating point operations; Matrices/Arrays – creation, operations; simple plotting commands – 2D/3D.

- a. Exercise Set-1: Run MATLAB, find the command window and the blinking cursor. Find the answer to the following arithmetic problems:
- i. $1234 + 4321 = ?$
 - ii. $104 - 765 = ?$
 - iii. $47 * 33 = ?$
 - iv. $34 = ?$ (The operator for “power” is the circumflex ^, usually found by pressing)
 - v. How far is 19^2 from its approximation $20^2 - 2*20$? (Remember that $(a-b)^2 = a^2 - 2ab + b^2$?, thus the answer should be ± 1)
 - vi. Find an approximation to $1/73$
 - vii. Find an approximation to $\sqrt{31}$ (while you can of course use the fact that $\sqrt{x} = x^{0.5}$, you can also “look for” a dedicated function square root by learning how to use the ***lookfor*** command....)
 - viii. If you get 5% interest-rate (yearly) on a loan, compounded monthly, and you start with Rs.1000, how much money will you have after 20 years? (don’t be confused by an answer of the form $2.7e3$ which simply means 2.7×10^3)
 - ix. If two sides of a right triangle have lengths 31 and 45, what is the length of the hypotenuse?
 - x. You are asked by your boss to create a digital thermometer that displays only integral temperatures in °F after measuring temperature in °C in 4 decimal places. Give your answers for a rounded up value as well as the next higher integer value. Give the range in which your answer lies like [U, L]

b. Exercise Set-2:

- i. In a single M command calculate the following:

$$\sqrt{\frac{(4.172 + 9.131844)^3 - 18}{-3.5 + (11.2 - 4.6) * (7 - 2.91683)^{-0.4}}}$$

- ii. Find(manually) the root of the following equation within the interval [2, 4].

$$0.5(x - 2)^3 - 40 \sin(x) = 0$$

- iii. For (i) use Format long/short commands to display the answers.
- iv. For (i) use **Format long**/short commands to store the answers in 2 different variables. Use **Disp()** command to display the 2 variables.
- v. Compute the following and display in short decimal format:

1. $\frac{2^5}{2^5-1}$ and compare with $\left(1 - \frac{1}{2^5}\right)^{-1}$

$$2. \frac{\sqrt{5}-1}{(\sqrt{5}+1)^2}$$

- vi. Compute the following and display your answers in long decimal format upto 10 decimal places.
1. e^3
 2. $\ln(e^3)$
 3. $\log_{10}(e^3)$
 4. $\log_{10}(10^5)$
- vii. Compute the following
1. $\sin(\pi/6)$
 2. $\cos(\pi)$
 3. $\tan(\pi/2)$
 4. $\sin^2(221\pi)+\cos^2(221\pi)$
- c. Exercise Set-3:
- i. Compute the value of the expression $y = e^{-a}\sin(\pi x) + 10\sqrt{y} + \log(142)$ for $a = 5$, $x = 2$, and $y = 8$
 1. Display your result in a 2 digit decimal format
 2. Use Fomat Long to display the result.
 - ii. Using the cosine rule ($c^2 = a^2 + b^2 - 2ab\cos(\theta)$), find the length of thehypotenuse of a triangle with angle 30° , and sides with lengths 10 and 20. The Matlab trigonometric functions (cos, sin, tan) use radians, so you will need to convert using π .
- d. Exercise Set-4: Matrices/Arrays/Vectors
- i. $w = [1 \ 2 \ 3 \ 4; 5 \ 6 \ 7 \ 8; 9 \ 10 \ 11 \ 12]$
 1. Display the size of the above matrix.
 2. Compute the determinant of the above matrix.
 3. Display the element in the 2nd row and 4th column.
 4. Display the 3rd row of the matrix w
 5. Display the 3rd column of the matrix w
 - ii. For w type the following
 1. $v = w(2:3,2:4)$. Display v.
 2. $z = w([2,3] , [2,4])$. Display z. What is displayed by this command?
 - iii. For w calculate the inverse. Is it possible? What message is displayed?
 - iv. Solve the following set of equations:

$$\begin{aligned} -2x + y &= 3 \\ x + y &= 10 \end{aligned}$$
 - v. Solve the following set of equations:

$$\begin{aligned} 5x &= 3y - 2z + 10 \\ 8y + 4z &= 3x + 20 \\ 2x + 4y - 9z &= 9 \end{aligned}$$
 - vi. Create variables to represent the following matrices:

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 2 & 2 \\ -1 & 2 & 1 \end{bmatrix} \quad B = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 1 & 1 \end{bmatrix} \quad C = \begin{bmatrix} 1 & 1 \\ 2 & 1 \\ 1 & 2 \end{bmatrix}$$

Try performing the following operations:

1. $A + B$
2. $A * B$
3. $A + C$
4. $B * A$
5. $B - A$
6. $A + C$
7. $C - B$
8. $C * A$

Display the results. Show the error messages generated. What are the reasons?

What is the difference between $A * B$ and $A \cdot B$?

- vii. Find the determinants of A, B & C. What is the message displayed for C?
- viii. Find the ranks of A, B & C.
- ix. Also find the inverses of A, B & C.
- x. Type the following commands:

$$[L, U] = \text{lu}(A)$$

$$\text{Prod} = L * U$$

Compare the “Prod” and “A”. Are they equal?

- xi. Type the following commands:

$$A = [1 \ 0.5 \ 0.33 \ 0.25; \ 0.5 \ 1 \ 0.67 \ 0.5; \ 0.33 \ 0.67 \ 1 \ 0.75; \ 0.25 \ 0.5 \ 0.75 \ 1]$$

$$[V, D] = \text{eig}(A)$$

Compute $A * V - D * V$. Is it equal to 0? Is it at least close to zero?

- xii. Type the following commands:

$$A = [3 \ 1 \ 0; \ 0 \ 3 \ 1; \ 0 \ 0 \ 3];$$

$$[V, D] = \text{eig}(A)$$

Compute $A * V - D * V$. Is it equal to 0? Is it at least close to zero?

- xiii. Create a row vector of length 3 and assign its value to P. Then type the following the commands to solve the equation $x^2 + 4x + 4 = 0$. And also to find the value of the polynomial at 5.

$$P = [1 \ 4 \ 4]$$

$$R = \text{roots}(P)$$

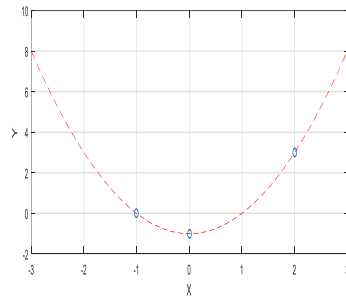
$$\text{Val} = \text{polyval}(P, 5)$$

Now use the above commands to find the roots of the following polynomials. Also find the values of the following polynomials at $x = 1, 10$ & 100 .

1. $x^3 - 3x^2 + 3x - 1$
2. $3x^3 + 20x^2 - 25x - 250$
3. $x^5 + 56x^4 - 32x^3 - 34930x^2 - 226625x + 1972250$

xiv. Create 2 row vectors of length 3 and assign them to X and Y. Then type the following the commands to fit a polynomial of 2nd degree to the data vectors. And also plot the curve of the polynomial.

```
>> X = [-1 0 2]
>> Y = [0 -1 3]
>> P2 = polyfit(X,Y,2);
>> plot(X,Y,'o')
>> hold on;
>> x = -3:0.01:3;
>> plot(x, polyval(p2,x), 'r--');
```



xv. Create a vector t that ranges from 1 to 10 in steps of 1 and a vector theta that ranges from 0 to π and contains 32 elements. Now compute the following:

1. $x = 2 \sin(\theta)$
2. $y = \frac{t-1}{t+1}$
3. $z = \frac{\sin(\theta^2)}{\theta^2}$