Autonomous Program Structure

Final Year B. Tech.

Eighth Semester (Mechanical Engineering)

2016 Pattern (R0)

Course Code	Course Title	Teaching Scheme Hours/ Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Oral	Practical		
ME 4201	Turbo Machines	3	0	0	50	50	0	0	100	3
PEME 4201	Program Elective-I	3	0	0	50	50	0	0	100	3
OE 4201	Open Elective-II	3	0	0	50	50	0	0	100	3
ME 4202	Turbo Machines Lab	0	0	2	0	0	50	0	50*	1
ME 4203	Project Phase-II	0	2	16	100	0	50	0	150	10
ME 4204	Project based Online Course**	2	0	0	50	0	0	0	50	2
	Total	**11**	**2**	**18**	**300**	**150**	**100**	**0**	**550**	**22**
	Grand Total	**31**			**550**					

**The student shall register and complete the project based online course preferably in semester-I but may complete the same till the end of semester-II.

PEME 4201: Programme Elective-I
1) Mechanical Vibrations
2) Advanced Manufacturing Processes
3) Refrigeration and Air conditioning
4) Energy Storage Management

OE 4201: Open Elective-II
1) Renewable Energy Sources
2) Operations Research

ME 4201 – Turbomachines

Teaching Scheme

Lecture: 3 Hrs/week

Examination Scheme

In semester: 50 marks

End semester: 50 marks

Credits: 3

Prerequisites:

1. Applied Thermodynamaics
2. Fluid Mechanics

Course Objectives:

1 Application of basic flow equations to various machines can be done by students

2 Train the students to acquire the knowledge and skill of analyzing different turbo machines.

3 Comparison and selection of machines for various operations

Course Outcomes:

Upon completion of this course, the student will be able :

1 To calculate efficiency of for impulse and reaction turbine

2 Demonstrate the different types of turbines, pumps and compressors

3 Interpret the type of turbomachines and illustrate inlet and outlet conditions with the help of velocity triangles.

4 Identify the type of turbomachines for given application

Unit 1: Introduction & Hydraulic Turbines 10 Hrs

Turbo machines (Hydraulic & Thermal), Classification of Turbo machines, Comparison with positive displacement machines, Fundamental equation governing turbo machines,
Pelton wheel- Construction, principle of working, velocity diagrams and analysis, design aspects,
Reaction Water Turbines : Classifications, Francis, Propeller, Kaplan Turbines, construction features, velocity diagrams and analysis, degree of reaction, Draft tubes: types and analysis,

Unit 2: Performance Characteristics of turbomachines 5 Hrs.

Governing and performance characteristics, specific speed, selection of turbines, Introduction to Steam Turbines

Unit 3: Centrifugal Pumps 8 Hrs.

Classification of rotodynamic pumps, components of centrifugal pump, types of heads, velocity triangles and their analysis, effect of outlet blade angle, cavitation, NPSH, Thoma‟s cavitation factor, specific speed, performance characteristics of centrifugal pump, series and parallel operation of pumps, system resistance curve, selection of pumps. Cavitation, open, semi open impeller pumps

Unit 4: Centrifugal Compressor 8 Hrs.

Classification of rotodynamic compressors, blowers, fans. Centrifugal compressor: Construction, flow

process on T-S Diagram, velocity diagram and Euler's work, slip factor and its effect on work input, actual work input, dimension parameters, pre-whirl losses, surging, choking, stalling characteristics.

Unit 5: Axial Compressor **8 Hrs.**

Construction, stage velocity triangles and its analysis, enthalpy entropy diagram, dimensionless parameters, flow through the blade rows, pressure rise across the stage, stage losses and efficiencies, Performance characteristics.

Suggested Texts and Reference Materials:

1 William W. Peng, Fundamentals of Turbomachinery, John Wiley & Sons.
2 Turbines, Compressors & Fans, S.M. Yahya, Tata-McGraw Hill
3 S.L. Dixon, Fluid Mechanics, Thermodynamics of Turbomachinery, IV edition, Butterworth-Heinemann Publ., 1966.
4 Karassik, Hand Book of Pumps, Tata McGraw Hills Ltd., New Delhi.

PEME4201 – Mechanical Vibrations

Teaching Scheme

Lecture: 3 Hrs/week

Examination Scheme

In semester: 50 marks

End semester: 50 marks

Credits: 3

Prerequisites:

1. Rigid body dynamics
2. Machines and Mechanisms
3. Machine Design

Course Objectives:

1. To determine the natural frequency of free undamped system.
2. To analyze the given systems subjected to damped vibrations.
3. To compute the amplitude and phase difference for a system subjected to forced vibrations.
4. To explain features and applications of vibration measuring devices.
5. To describe various control methods.
6. To understand basics of noise measurement and control.

Course Outcomes: The students will be able to,

1. determine the natural frequency of free undamped system.
2. analyze the given systems subjected to damped vibrations.
3. compute the amplitude and phase difference for a system subjected to forced vibrations.
4. explain features and applications of vibration measuring devices.
5. describe various control methods.
6. explain basics of noise measurement and control

Unit 1: Single Degree of Freedom Systems – Free Vibration 8 Hrs

Fundamentals of Vibration: Elements of a vibratory system, S.H.M., degrees of freedom, modeling of a system, concept of linear and non-linear systems, equivalent spring, linear and torsional systems. **Undamped free vibrations:** Natural frequency by equilibrium and energy methods for longitudinal and torsional vibrations.

Unit 2: Damped free vibrations: 6 Hrs

Different types of damping, free vibrations with viscous damping - over damped, critically damped and under damped systems, dry friction damping.

Unit 3: Single Degree of Freedom Systems - Forced Vibrations **6 Hrs**

Forced vibrations of longitudinal and torsional systems, simple harmonic excitation, excitation due to reciprocating and rotating unbalance, base excitation, magnification factor and phase difference, force and motion transmissibility.

Unit 4: Two Degree of Freedom Systems - Undamped Vibrations **6 Hrs**

Free vibration of spring coupled systems – longitudinal and torsional, natural frequency and mode shapes. Eigen value and Eigen vector by Matrix method, Geared systems.

Unit 5: Vibration Measurement and Control **8 Hrs**

Vibration measurement: Basics of vibration measurement, vibration measuring devices, FFT Analyzer, vibration exciters. Vibration standards.

Vibration control: Control of natural frequency, vibration isolators, and absorbers, control at source, path, receiver. Active and passive systems.

Unit 6: Introduction to Noise **6 Hrs**

Fundamentals of acoustics, decibels, sound pressure level, sound intensity, sound fields, sound reflection, absorption and transmission, pass-by-noise, noise measurement environments, noise standards.

Suggested Texts and Reference Materials:

1. Rao S. S., ‘Mechanical Vibrations’, Pearson Education Inc. Dorling Kindersley (India) Pvt. Ltd.
2. Grover G. K., ‘Mechanical Vibrations’, Nem Chand and Bros.
3. Thomson, W. T., ‘Theory of Vibration with Applications’, CBS Publishers and Distributors.
4. V P Singh, ‘Mechanical Vibrations’, Dhanpat Rai & Sons.
5. Kelly S. G., ‘Mechanical Vibrations’, Schaum‘s outlines, Tata McGraw Hill Publishing Co. Ltd.
6. Meirovitch, ‘Elements of Mechanical Vibrations’, McGraw Hill.
7. M.L.Munjal, ‘Noise and vibration control’, Cambridge University Press India Private Limited.
8. Bies, D. and Hansen, C., ‘Engineering Noise Control - Theory and Practice’, Taylor and Francis.

PEME 4201   Advanced Manufacturing Processes

Teaching Scheme

Lectures: 3Hrs/week

Examination Scheme

In Semester: 50marks

End Semester: 50 Marks

Credits: 3

Pre-requisite: MP-I, MP-II.

Objectives:

1. To impart the fundamentals of various metal cutting practices, fundamentals of machine tools and processes.
2. To impart fundamental knowledge of non-traditional and MEMS machining.

Course Outcomes: Students will be able to,

1. Describe features and applications of screw thread and gear manufacturing processes.
2. Demonstrate finishing processes like polishing, burnishing, buffing.
3. Exploit use of non-traditional and MEMS machining processes to diversify and improve manufacturing technology in the region.
4. Judge the limitations and scope of machines to perform variety of operations.

Unit 1: Manufacturing and Finishing Processes for Screw Threads and Gear: 6 Hrs

Basic Introduction, thread milling, die threading, Thread rolling, Thread grinding. Gear hobbing, Hobbing technique, Gear finishing processes- gear shaving, gear lapping, gear grinding and gear burnishing. Roller burnishing process. Super finishing processes (Polishing, Buffing).

Unit 2: Non-Traditional machining processes: 8 Hrs

Introduction, Principle of ECM process, parameters of the processes, electrochemical grinding, electrochemical deburring, chemical machining. Abrasive flow machining (AFM), Magnetic abrasive finishing (MAF) – working, system, rocess variables, performance parameters and applications

Unit 3: MEMS: 6 Hrs

Introduction to MEMS, Definition and classification – applications, Bulk Micromachining, Wet and Dry Etching, Surface Micromachining, Chemical Vapor Deposition, Lithography, Wafer Bonding.

Unit 4: Advanced Metal Forming and Welding: 6 Hrs

High velocity hydro forming, High velocity mechanical forming, electromagnetic forming, High Energy Rate forming (HERF), Spinning (introduction to shear Spinning). Friction Stir Welding, Thermit welding,

Unit 5: Additive Manufacturing Processes: 6 Hrs

Introduction, principles and development in additive manufacturing technology, powder based fusion process, extrusion based system, sheet lamination process, direct write technologies.

Unit 6: E-MANUFACTURING: **6 Hrs**

Nano manufacturing techniques and micromachining, High Speed Machining and hot machining

Text Book:

1. Manufacturing, Engineering and Technology SI, Serope Kalpakjian, Steven R. Schmid, Pearson (2005)

Reference Books:

1. Fundamentals of Modern Manufacturing – Materials, Processes and Systems, M. P. Groover, Wiley India, 5th Edition.
2. V. K. Jain, Advanced Machining Processes, Allied Publishers Pvt. Ltd. 2002.
3. Elements of Workshop Technology: Machine Tools (Volume – 2) by S. K. Hajra Choudhary, A. K. Hajra Choudhary, Nirajhar Roy, Media promotors (2010).
4. Sheet metal forming: Processes and applications – Tayalam Atlan, ASM International USA.
5. Friction Stir welding and Processing – Rajiv S. Mishra, ASM International.
6. Additive Manufacturing Techniques – Ian Gibson, Springer.

PEME 4201 – Refrigeration and Air Conditioning

Teaching Scheme	**Examination Scheme**
Lecture: 3 Hrs/week	In semester: 50 marks
	End semester: 50 marks
	Credits: 3

Prerequisites:

1. Engineering Thermodynamics
2. Heat Transfer
3. Applied Thermodynamics

Course Objectives:

1 To determine the performance parameters of vapour refrigeration system.
2 To estimate thermal performance of various refrigeration and air conditioning system components.
3 To do performance calculations for multistage refrigeration system.
4 To calculate load for air conditioning system
5 To analyze air distribution system.

Course Outcomes: Upon completion of this course, students will be able to:

1 Understand properties and environmental issues of various refrigerants.
2 Calculate the performance parameters of vapour refrigeration system.
3 Estimate thermal performance of various refrigeration and air conditioning system components.
4 Do performance calculations for multistage refrigeration system.
5 Calculate load for air conditioning system.
6 Analyze air distribution system

Unit 1 Refrigerants **3 hrs**

Classification of refrigerants, Designation of refrigerants, Desirable properties of refrigerants, environmental issues, Ozone depletion and global warming, ODP, GWP & LCCP, selection of environment friendly refrigerants, secondary refrigerants, anti-freeze solutions, Zeotropes and Azeotropes, refrigerant: recovery reclaims, recycle and recharge.

Unit 2 Vapour Refrigeration System **7 hrs**

Review of vapour compression cycle, advanced vapour compression cycles, Review of vapour absorption system, aqua ammonia system, three fluid system (Electrolux refrigerator).

Unit 3 Thermal Design of Refrigeration and Air Conditioning System Components **8 hrs**

Compressor: characteristic curves of reciprocating and centrifugal compressors, sizing of reciprocating compressor
Evaporator: types, Performance analysis
Condenser: air-cooled condenser, shell and tube condenser and evaporative condenser.
Expansion Devices: - capillary tube, thermostatic expansion valve, electronic expansion valve, operating Characteristics
Cooling Tower: types and design of cooling towers, thermal performance

Unit 4 Multi pressure Refrigeration system **7 hrs**

Review of basics of multi pressure refrigeration system, cascade system, multi evaporator system. Individual and multiple expansion valve, multistage compression.
Introduction to Cryogenics (Linde - Hampson cycle) and applications.

Unit 5 Air Conditioning Load Estimation **7 hours**

Types of air conditioning systems
Review of psychometric processes, thermodynamics of human body, Concept of infiltration and ventilation, indoor air quality requirements, Ventilation for cooling (Natural ventilation and Mechanical Ventilation) Solar radiation, Cooling load temperature difference method
Concept of ECBC (Energy Conservation Building Code)

Unit 6 Air Distribution System **7 hrs**

Ducts: Classification of ducts, duct material, pressure in ducts, flow through duct, pressure losses in duct (friction losses, dynamic losses), air flow through simple duct system, equivalent diameter, methods of duct system design: equal friction, velocity reduction, static regain method.
Air handling unit: fan coil unit, types of fans used air conditioning applications, fan laws, filters, supply and return grills, sensors (humidity, temperature, and smoke).

Suggested Texts and Reference Materials:

1 Arora C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill
2 Manohar Prasad, Refrigeration and Air Conditioning, Willey Eastern Ltd
3 McQuiston, Heating Ventilating and air Conditioning: Analysis and Design, Wiley India
4 Arora and Domkundwar, Refrigeration & Air Conditioning, Dhanpat Rai & Company, New Delhi
5 ASHRAE Handbooks
6 Threlkeld J.L., Thermal Environmental Engineering, Prentice Hall Inc. New Delhi
7 Shan Wang, Handbook of Refrigeration and Air Conditioning, McGraw Hill Publications

PEME 4201 Energy Storage and Management

Teaching Scheme

Lectures 3 hrs/week

Examination Scheme

In Semester- 50Marks

End Semester- 50 Marks

Credits-3

Prerequisite: Basics of electrical engineering, Engineering Thermodynamics, Economics.

Course Objective:- Students will be able to :-

1. Understand different energy systems, their economics and Management.
2. Use these knowledge to analyse and design simple energy storage system.
3. Formulate and solve equations and model containing energy storage elements
4. Understand build a simple energy storage systems and take measurements to compare measurements of different energy storage systems.
5. Understand relationship between mathematical representation of energy storage systems and corresponding real life effects.

Course Outcome:- Student will be able to demonstrate knowledge and understanding of:

1. Fundamentals of energy storage application (e.g. temporal storage needs) and principles of energy conversion
2. Principles of battery and other electro-chemical systems such as super-capacitors, fuel cells, and mechanical energy storage systems
3. Principles of energy storage and energy management systems
4. Be able to propose, analyze and size an energy storage system for a given application.
5. Compare different engineering technologies from various perspectives such as storage, efficiency and economics.

Unit 1 Mechanical Energy Storage: 6 Hrs

Potential Energy Storage , Energy Storage in Pressurized Gas, Potential Energy Storage Using Gravity, Hydroelectric Power, Pumped-Hydro Storage. Use of the Kinetic Energy in Moving Water, Kinetic Energy in Mechanical Systems**,** Linear Kinetic Energy, Rotational Kinetic Energy, Internal Structural Energy Storage, Energy Storage in Ultra-high speed Flywheel

Unit 2 Electro-chemical and Electromagnetic Storage 8 Hrs

Introduction Simple Chemical and Electrochemical and electromagnetic Reactions ,Major Types of Reaction Mechanisms in Electrochemical Cells. The Operating Voltage and the Concept of Energy Quality,The Charge Capacity The Maximum Theoretical Specific Energy, Variation of the Voltage as Batteries Discharged and Recharged, Cycling Behavior ,Self-Discharge ,Lead-Acid Batteries, Lithium ion batteries, Energy in a Parallel Plate Capacitor, Electrochemical Charge Storage Mechanisms, Electrostatic Energy Storage in the Electrical, Ultracapacitors (Energy Storage in Capacitors).

Unit 3 Hydrogen Storage **6 Hrs**

Introduction,The Production of Hydrogen ,The Steam Reforming Process,The Reaction of Steam with Carbon, Electrolytic Production of Hydrogen ,Thermal Decomposition of Water to Produce Hydrogen, Chemical Extraction of Hydrogen from Water ,Current On-Board Hydrogen Storage Alternatives ,Storage of Gaseous Hydrogen in High Pressure Tanks ,Storage of Liquid Hydrogen in Insulated Tanks ,Storage of Hydrogen as Protons in Solids; Metal Hydrides , Hydrogen fuel cell.

Unit 4 Energy Management **6 Hrs**

Need of Energy Audit, Types of energy audit, Energy audit methodology, Instruments - equipment used in energy audit. Principles of Energy management, Energy policy, Energy action planning, Energy security and reliability, Energy and environment, Need of Renewable and energy efficiency. Electricity billing, Electrical load management and maximum demand control, Power factor Improvement and its benefit, Selection and location of capacitors, Distribution and transformer losses.

Unit 5 Energy Economics **6 Hrs**

Investment – Need of Energy Economics, Financial analysis techniques - Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis, Financing options.

Unit 6 Thermal Energy Utilities **6 Hrs**

Energy performance assessment and efficiency improvement of DG Set, Heat exch-angers, Pumps, Compressors. Carbon credit calculations.

Reference and Text Books:-

1. Energy Storage by Robert A. Huggins Springer Publication
2. Energy storage (A new approach) by Ralph Zito Wiley Publication
3. Handbook of Energy Audit, Albert Thumann P.E. CEM, William J. Younger CEM, The Fairmont Press Inc., 7 th Edition.
4. Energy Management Handbook, Wayne C. Turner, The Fairmont Press Inc., 5th Edition,Georgia.
5. Handbook on Energy Audit and Environment management, Abbi Y. A., Jain Shashank, TERI, Press, New Delhi, 2006
6. Energy Performance assessment for equipment and Utility Systems.-Vol. 2,3.4 BEE Govt. of India
7. www.enrgymanagertraining.com
8. http://www.bee-india.nic.in

OE 4201 -Renewable Energy Sources

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 50 marks
End semester: 50 marks
Credits: 3

Pre-requisites:- None

Course Objectives:-

1. Students will be able to understanding basic characteristics of renewable sources of energy and technologies for their utilization.
2. Students will learn engineering approach for renewable energy projects.
3. Students will analyze energy potential of renewable sources of energy.

Course Outcome:-

1. Students will be able to Understand of different renewable sources of energy and technologies for their utilization.
2. Select engineering approach to problem solving when implementing the projects on renewable sources of energy.
3. Undertake simple analysis of energy potential of renewable sources of energy.
4. Students will be able to describe main elements of technical systems designed for utilisation of renewable sources of energy.

Unit1. Solar Energy **8 Hrs**

Solar potential, Solar radiation geometry, Solar radiation data, radiation measurement, Types of Solar Collectors, Collection efficiency, Testing of Solar collectors – IS code, Applications of Solar Energy, Solar Desalination system, Solar dryer, Concentrating collectors, line type- point type Solar Energy storage. Solar PV Principle, Photo-cell materials, Solar batteries, solar tracking system,

Unit2. Wind Energy **6 Hrs**

Wind parameters and wind data, Power from wind, Site selection, Wind energy conversion systems and their classification, Construction and working of typical wind mill, characteristics of wind generators, Design considerations for wind mills, Operation and maintenance of wind mills, wind farms, floating wind turbine, transitional depth technology, deepwater floating technology.

Unit3. Biomass Technology **6 Hrs**

Introduction, Energy plantation, Combustion and fermentation, Biomass gasification, types of gasifire, Updraught, downdraught, crossdraught Pyrolysis, various applications of Biomass energy, Bio-fuel types, Biomass gasification boiler

Unit4. Hydro Power systems **6 Hrs**

Introduction, types and system components, discharge curve and estimation of power potential, turbines for hydro power system, pump storage system

Unit5. Waste Heat Recovery Technology **6 Hrs**

Introduction, classification, advantages and application, commercially viable waste heat recovery devices, saving potential

Unit6. Hybrid Energy Systems **6 Hrs**

Need for Hybrid systems, Range and type of hybrid systems, Case studies of Solar-PV, Wind-PV, Micro hydel-PV, Biomass-Diesel systems, 2,3,4 Way Hybrid Energy System. Applications for hybrid energy system.

Reference Books:

1. Solar Energy by Dr. S.P.Sukhatme Tata McGraw Hill.
2. Non Conventional Energy Sources by G.D.Rai.- Khanna Publishers.
3. Energy Technology by S. Rao, Dr. B.B.Parulekar Khanna Publishers.
4. Godfrey Boyle, Renewable Energy, Power for a sustainable future, Oxford university
5. Energy Engineering by R.S. Kulkarni & Dr. S.V. Karmare.
6. Non Conventional Energy Sources by Dr. L. Umanand.
7. Introduction to Non Conventional Energy Resources by Raja, SciTech Publications.

OE 4201 Operations Research

Teaching Scheme

Lectures: 3Hrs/week

Examination Scheme

In Semester: 50 marks

End Semester: 50 Marks

Credits: 3

Pre-Requisites: Engineering Mathematics, Theory of probability, Statistics.

Course Objectives

1. To familiarize the students with the use of practice oriented mathematical applications for optimization functions in an organization.
2. To familiarize the students with various tools of optimization, probability, statistics and simulation, as applicable in particular scenarios in industry for better management of various resources.

Course Outcomes: Learner will be able to.....

1. Illustrate the need to optimally utilize the resources in various types of industries.
2. Formulate and analyze various real life industrial operations.
3. Apply Operations Research techniques to industrial operations.
4. Demonstrate cost effective strategies in various applications in industry.

Unit 1: Introduction: Operation Research **8 hrs**

Introduction: Definition, Evolution and Classification of Quantitative Methods and Operations Research Techniques, Methodology, Advantages and Limitations.
Linear Programming: Introduction, Formulation, Simplex Method (Big – M and Two Phase Methods), Dual Simplex Method (Conversion of primal to dual)
Introduction to Sensitivity Analysis.
Decision Theory: Meaning and Steps in Decision Making, Types of Management Decisions, Decision under Certainty, under Risk, under Uncertainty, Decision Trees.

Unit 2: Transportation Model **8 hrs**

Introduction, Formulation, Basic Method of Solving Transportation Problem, Optimization Methods like UV and Stepping Stone Method, Concept of Trans-shipment Methods as an Extension of Transportation.
Assignment Problem- Hungarian Method to solve Assignment Problem, Travelling Salesman as an Extension of Assignment Problem.

Unit 3: Theory of Games and Investment Analysis **8 hrs**

Theory of Games : Introduction, Minimax and Maximin Principle, Solution of Game with Saddle Point, Solution by Dominance, Solution by Graphical Method, m x n size Game Problem, Iterative method, Introduction to formulation of games using Linear Programming.
Investment Analysis: Break-Even Analysis, Payback Period Method, A (A) R Method, DCF Method, IRR Method, Introduction to Probabilistic Models.

Unit 4: Inventory Control and Replacement Analysis **8 hrs**

Inventory Control - Deterministic Models- Shortage, without shortage; Probabilistic Inventory Models, Introduction to Concept of Service level.
Replacement Analysis - Replacement of Items that Deteriorate, Replacement of Items that Fail Suddenly.

Unit 5: Queuing Theory and Sequencing models **8 hrs**

Queuing Theory - Introduction, Basis Structure, Terminology (Kendal‘s Notations) and Applications. Queuing Model M/M/1: /FIFO, M/M/c.
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Sequencing models: Solution of sequencing Problem - Processing of n jobs through two machines, Processing of n jobs through three machines, Processing of two jobs through m Machines, Processing of n jobs through m Machines

Unit 6: Network Models **8 hrs**

Network Models: Fulkerson‘s rule, concept and types of floats, CPM and PERT, Introduction to crashing.
Simulation: Introduction, Monte-Carlo Simulation method, Simulation of Inventory and Queuing Problems.
Introduction to Multi Object Decision Making: Goal Programming Formulation.

Text Books

1. N. D. Vora, Quantitative Techniques.
2. Prem Kumar Gupta, D. S. Hira, Problems in Operations Research: Principles and Solutions, S. Chand, 1991
3. J. K. Sharma, Operations Research : Theory And Application, Laxmi pub. India.
4. Operations Research, S. D. Sharma, Kedar Nath Ram Nath-Meerut.

Reference Books

1. Belegundu, ― Optimization Concepts and Applications in engineering, Cambridge Uni. Press, India
2. Hillier F.S., and Lieberman G.J., Operations Research, Eight Edition, Mc. Tata McGraw Hill, India
3. Ravindran, ―Engineering optimization Methods and Appliations‖, 2nd edition, Wiley, India
4. Ravindran, Phillips and Solberg, Operations Research Principles and Practice, Second Edition, Mc. WSE Willey,
5. Operations Research - An introduction, Hamdy A Taha, Pearson Education.

ME 4202 – Turbo machines Lab

Teaching Scheme

Lab: 2 Hrs/week

Examination Scheme

Oral: 50 marks

Credits: 1

Prerequisites:

1. Applied Thermodynamics
2. Fluid Mechanics

Co - requisites:

1. Turbomachines

Course Objectives:

1. To conduct experiments involving various parameters of different turbo machines
2. To calculate the output parameters of given turbomachines based on the input parameters
3. To Illustrate the characteristics in the graphical form
4. To Compare the results with available characteristic curves and deduce the conclusion from it

Course Outcomes: Upon completion of this lab course, the student will be able to:

1. Conduct experiments involving different turbomachines
2. calculate the output parameters of given turbomachines based on the input parameters
3. plot the various characteristics curves
4. Compare the results with available theoretical/experimental results and deduce the conclusion from it

List of Experiments:

1. Verification of impulse moment principle
2. Study and trial on impulse water turbine (Pelton wheel) and plotting of main and operating characteristics
3. Study and trial on any one hydraulic reaction turbine and plotting of main and operating characteristics
4. Study and trial on centrifugal pump and plotting operating characteristics
5. Study and trial of rotary compressors.
6. Visit to hydro/steam power plant and report to be submitted.
7. Performance Test on Gear (Oil) Pump Test Rig

ME 4203 – Project Phase -II

Teaching Scheme

Tutorial: 2 Hrs/week

Lab : 16 Hrs./week

Examination Scheme

In-Sem : 100 marks

Oral: 50 marks

Credits: 10

Course Outcomes:

On completion of the course, students will be able to -

1. extract desired understanding and conclusions consistent with objectives and limitations of the analysis by using mechanical engineering concepts
2. build models/prototypes to develop diverse set of design solutions
3. use appropriate procedures, tools and techniques to conduct experiments to identify various engineering roles
4. demonstrate effective communication, problem solving, conflict resolution and leadership skills considering moral & ethical principles
5. read, understand and interpret technical and non-technical information
6. produce clear, well-constructed, and well-supported written engineering documents
7. use project management tools to schedule a sustainable engineering project so it is completed on time and on budget

INSTRUCTIONS FOR DISSERTATION WRITING (Project Stage I)

1. Print the manuscript using
   a. Letter quality computer printing.
   b. The main part of manuscript should be Times New Roman 12 pt. with alignment - justified.
   c. Use 1.5 line spacing.
   d. Entire report shall be of 5- 7 chapters.
2. Use the paper size 8.5'' × 11'' or A4 (210 × 197 mm). Please follow the margins given below. Margin Location
   a. Top - 1‘‘ (25.4 mm)
   b. Left - 1.5'' (37 mm)
   c. Bottom - 1.25'' (32 mm)
   d. Right - 1'' (25.4 mm)
3. The footer must include the following: Institute Name, B.Tech. (Mechanical) Times New Roman 10 pt. and centrally aligned.
4. Page number as second line of footer, Times New Roman 10 Pt, centrally aligned.
5. All paragraphs will be 1.5 lines spaced with a one blank line between each paragraph. Each paragraph will begin with without any indentation.
6. Section titles should be bold with 14 pt typed in all capital letters and should be left aligned.

7. Sub-Section headings should be aligning at the left with 12 pt, bold and Title Case (the first letter of each word is to be capitalized).
8. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, black and white. Illustrations downloaded from internet are not acceptable.
    a. Illustrations should not be more than two per page. One could be ideal
    b. Figure No. and Title at bottom with 12 pt
    c. Legends below the title in 10 pt
    d. Leave proper margin in all sides
    e. Illustrations as far as possible should not be photo copied.
9. Photographs if any should be of glossy prints
10. Please use SI system of units only.
11. Please number the pages on the front side, centrally below the footer
12. References should be either in order as they appear in the thesis or in alphabetical order by last name of first author
13. Symbols and notations if any should be included in nomenclature section only
14. Following will be the order of report
    a. Cover page and Front page as per the specimen on separate sheet
    b. Certificate from the Institute as per the specimen on separate sheet
    c. Acknowledgements
    d. List of Figures
    e. List of Tables
    f. Nomenclature
    g. Contents
    h. Abstract (A brief abstract of the report not more than 150 words. The heading of abstract i.e. word Abstract‖ should be bold, Times New Roman, 12 pt and should be typed at the centre. The contents of abstract should be typed on new line without space between heading and contents. Two sentences each on motive, method, key-results and conclusions in Abstract

The main body of your report will contain:

1. Introduction (Times New Roman (TNR) – 14 Bold)
    a. Problem statement (TNR – 12)
    b. Objectives
    c. Scope
    d. Methodology
    e. Organization of Dissertation
2. Literature Review: Discuss the work done so far by researchers in the domain area and their significant conclusions. No derivations, figures, tables, graphs are expected.
3. This chapter shall be based on your own simulation work (Analytical/ Numerical/FEM/CFD)
4. Experimental Validation - This chapter shall be based on your own experimental work
5. Concluding Remarks and Scope for the Future Work

6. References
7. ANNEXURE (if any) (Put all mathematical derivations, Simulation program as Annexure)

Note:

1. All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3… and for subheadings 1.1, 1.2… etc and section subheadings 2.1.1, 2.1.2… etc.
2. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If figures and tables are taken from any reference then indicate source of it.

Please follow the following procedure for references

Reference Books

[1] Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3rd ed., Oxford University Press, UK, 1996, pp. 110 – 112.

Papers from Journal or Transactions

[1] Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, ASHRAE Trans, 1991, 97 (1), pp. 90 – 98.

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