ENERGY ENGINEERING

Course	Code	Credits	L-T-P	Assessment		Exam Duration
				SEE	CIA	
Energy Engineering	15ME71	04	3-2-0	80	20	3Hrs

Courselearning objectives is to

- Understand energy scenario,energy sources and their utilization
- Learn about energy conversion methods and their analysis
- Study the principles of renewable energy conversion systems
- Understand the concept of green energy and zero energy.

Module – I

Thermal Energy conversion system: Review of energy scenario in India,General Philosophy and need of Energy ,Different Types of Fuels used for steam generation,Equipment for burning coal in lump form, strokers, different types, Oilburners, Advantages and Disadvantages of using pulverized fuel, Equipmentfor preparation and burning of pulverized coal, unit system and bin system.Pulverized fuel furnaces, cyclone furnace, Coal and ash handling, Generationof steam using forced circulation, high and supercritical pressures.Chimneys: Natural, forced, induced and balanced draft, Calculations andnumerical involving height of chimney to produce a given draft. Coolingtowers and Ponds. Accessories for the Steam generators such asSuperheaters, De-superheater, control of superheaters, Economizers, Air preheatersand re-heaters.

9 Hours

Module – II

Diesel Engine Power System: Applications of Diesel Engines in Power field.Method of starting Diesel engines. Auxiliaries like cooling and lubricationsystem, filters, centrifuges, Oil heaters, intake and exhaust system, Layout ofdiesel power plant.

Hydro-Electric Energy: Hydrographs, flow duration and mass curves, unithydrograph and numerical. Storage and pondage, pumped storage plants, low, medium and high head plants, Penstock, water hammer, surge tanks,gates and valves. General layout of hydel power plants.

7 Hours

Module – III

Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Measurement of solar radiation data, Solar Thermal systems: Introduction; Basics of thermodynamics and heat transfer; Flat plate collector; Evacuated Tubular Collector; Solar air collector; Solar concentrator; Solar distillation; Solar cooker; Solar refrigeration and air conditioning; Thermal energy storage systems, Solar Photovoltaic systems: Introduction; Solar cell Fundamentals; Characteristics and classification; Solar cell: Module, panel and Array construction; Photovoltaic thermal systems

8 Hours

Module – IV

Wind Energy: Properties of wind, availability of wind energy in India, windvelocity and power from wind; major problems associated with wind power,wind machines; Types of wind machines and their characteristics, horizontaland vertical axis wind mills, coefficient of performance of a wind mill rotor(Numerical Examples).

Tidal Power: Tides and waves as energy suppliers and their mechanics;fundamental characteristics of tidal power, harnessing tidal energy,limitations. **8 Hours**

Module – V

Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies; Urban waste to energy conversion; Biomass gasification.

Green Energy: Introduction: Fuel cells: Overview; Classification of fuel cells; Operating principles; Fuel cell thermodynamics Nuclear, ocean, MHD, thermoelectric and geothermal energy applications; Origin and their types; Working principles, Zero energy Concepts

8 Hours

Course Outcomes

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

- Summarize the basic concepts of thermal energy systems,
- Identify renewable energy sources and their utilization.
- Understand the basic concepts of solar radiation and analyze the working of solar PV and thermal systems.
- Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, biogas.
- Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.
- Identify methods of energy storage for specific applications

TEXT BOOKS:

1. B H Khan, Non conventional energy resources, 3rd Edition, McGraw Hill Education
2. Principles of Energy conversion, A. W. Culp Jr., McGraw Hill. 1996

REFERENCE BOOKS:

1. S.P. Sukhatme, Solar Energy: principles of Thermal Collection and Storage, Tata McGraw-Hill (1984).
2. C. S. Solanki, “Solar Photovoltaic’s: Fundamental A pplications and Technologies, Prentice Hall of India, 2009.
3. L.L. Freris, Wind Energy Conversion Systems, Prentice Hall, 1990.

Scheme of Examination: Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

FLUID POWER SYSTEMS

Course	Code	Credits	L-T-P	Assessment		Exam Duration
				SEE	CIA	
Fluid Power Systems	15ME72	04	3-2-0	80	20	3Hrs

Course objectives:

CLO1	To provide an insight into the capabilities of hydraulic and pneumatic fluid power.
CLO2	To understand concepts and relationships surrounding force, pressure, energy and power in fluid power systems.
CLO3	To examine concepts centering on sources of hydraulic power, rotary and linear actuators, distribution systems, hydraulic flow in pipes, and control components in fluid power systems.
CLO4	Exposure to build and interpret hydraulic and pneumatic circuits related to industrial applications.
CLO5	To familiarize with logic controls and trouble shooting

Module 1: Introduction to fluid power systems

Fluid power system: components, advantages and applications. Transmission of power at static and dynamic states. Pascal's law and its applications. Fluids for hydraulic system: types, properties, and selection. Additives, effect of temperature and pressure on hydraulic fluid. Seals, sealing materials, compatibility of seal with fluids. Types of pipes, hoses, and quick acting couplings. Pressure drop in hoses/pipes. Fluid conditioning through filters, strainers; sources of contamination and contamination control; heat exchangers.

10 hours

Module 2: Pumps and actuators

Pumps: Classification of pumps, Pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump selection factors, problems on pumps.

Accumulators: Types, selection/ design procedure, applications of accumulators. Types of Intensifiers, Pressure switches /sensor, Temperature switches/sensor, Level sensor.

Actuators: Classification cylinder and hydraulic motors, Hydraulic cylinders, single and double acting cylinder, mounting arrangements, cushioning, special types of cylinders, problems on cylinders.

Construction and working of rotary actuators such as gear, vane, piston motors, and Hydraulic Motor. Theoretical torque, power,flowrate, and hydraulic motor performance; numerical problems. Symbolic representation of hydraulic actuators (cylinders and motors).

10 hours

Module3: Components and hydraulic circuit design

Components: Classification of control valves, Directional Control Valves-symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, and check valves.
Pressure control valves - types, direct operated types and pilot operated types.

Flow Control Valves -compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation.

Hydraulic Circuit Design: Control of single and Double -acting hydraulic cylinder, regenerative circuit, pump unloading circuit, double pump hydraulic system, counter balance valve application,hydrauliccylinder sequencing circuits, cylinder synchronizing circuit using different methods, hydraulic circuit for force multiplication;speedcontrol of hydraulic cylinder- metering in, metering out and bleed off circuits.Pilot pressure operated circuits.Hydraulic circuit examples withaccumulator.

10 hours

Module4: Pneumatic power systems

Introduction to Pneumatic systems:Pneumatic power system, advantages, limitations, applications, Choice of working medium. Characteristics of compressed air and air compressors. Structure of pneumatic control System, fluid conditioners-dryers and FRL unit.

Pneumatic Actuators: Linear cylinder –types of cylinders, working, end position cushioning, seals, mounting arrangements, and applications. Rotary cylinders- types, construction and application, symbols.

Pneumatic Control Valves: DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols.

10 hours

Module5: Pneumatic control circuits

Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and exhaust air throttling.
Signal Processing Elements: Use of Logic gates - OR and AND gates in pneumatic applications.
Practical examples involving the use of logic gates.
Multi- Cylinder Application: Coordinated and sequential motion control, motion and control diagrams. Signal elimination methods, Cascading method- principle, Practical application examples (up to two cylinders) using cascading method (using reversing valves).
Electro- Pneumatic Control: Principles - signal input and output, pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple signal cylinder application.

10 hours

COURSE OUTCOMES:

After studying this course, students will be able to:

CO1	Identify and analyse the functional requirements of a fluid power transmission system for a

	given application.
CO2	Visualize how a hydraulic/pneumatic circuit will work to accomplish the function.
CO3	Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application.
CO4	Select and size the different components of the circuit.
CO5	Develop a comprehensive circuit diagramby integrating the components selected for the given application.

TEXT BOOKS:

1. Anthony Esposito, “Fluid Power with applications”, Pearson edition,2000 .
2. Majumdar S.R., “Oil Hydraulics”,TalaMcGRawHllL, 2002 .
3. Majumdar S.R., “Pneumatic systems - Principles and Maintenance”,Tata McGraw-Hill, New Delhi, 2005

REFERENCE BOOKS:

1. John Pippenger, Tyler Hicks, “Industrial Hydraulics”, McGraw Hill International Edition, 1980.
2. Andrew Par, Hydraulics and pneumatics, Jaico Publishing House, 2005.
3. FESTO, Fundamentals of Pneumatics, Vol I,IIandIII.
4. Herbert E. Merritt, “Hydraulic Control Systems”, John Wiley and Sons, Inc.
5. Thomson, Introduction to Fluid power, PrentcieHall, 2004
6. John Watton, “Fundamentals of fluid power control”, Cambridge University press, 2012.

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

Learning Assignment:

The faculty will allocate one or more of the following experiments from group A and B to group of students(containing not more than fourstudents in a group):

Group A: Experiments on hydraulic trainer:

a. Speed control circuit using metering in and metering out technique

b. Regenerative and sequencing circuits.

c. Extend-Retract and Stop system of a linear actuator

d.Rapid Traverse and Feed circuit.

Group B: Experimentson pneumatic trainer:

a. Automatic reciprocating

circuit b. Speed control circuit

c. Pneumatic circuit involving shuttle valve/ quick exhaust valve

d. Electro pneumatic valves and circuit

Students should build up the above circuits on computer using software and simulate the flow of fluid during the operation. Afterwards, they themselves can physically connect the circuit on the hydraulic/pneumatic trainer and run the circuit. Record of experiments shall be submitted in the form of journal. Due credit must be given for this assignment (5 Marks).

List of Open Source Software/learning website:

1. Simulink
2. SimHydraulics

CONTROL ENGINEERING

Course	Code	Credits	L-T-P	Assessment		Exam Duration
				SEE	CIA	
Control Engineering	15ME73	04	3-2-0	80	20	3Hrs

Course Objectives	1. Modeling of mechanical, hydraulic, pneumatic and electrical systems. 2. Representation of system elements by blocks and its reduction 3. Transient and steady state response analysis of a system. 4. Frequency response analysis using polar plot. 5. Frequency response analysis using bode plot. 6. Analysis of system using root locus plots. 7. Different system compensators and variable characteristics of linear systems.

MODULE I

Introduction: Concept of automatic controls, Open loop and closed loop systems, Concepts of feedback, requirements of an ideal control system, Types of controllers-Proportional, Integral, Differential, Proportional & Integral, Proportional Differential and Proportional Integral Differential controllers.

(**7 Hours)**

MODULE 2

Modeling of Physical Systems : Mathematical Models of Mechanical, Electrical, Thermal, Hydraulic and Pneumatic Systems.
(3 hours)

Analogous Systems: Direct and inverse analogs for mechanical, thermal and fluid systems. **(4 hours)**

Block diagram Algebra: General representation of a feedback control system, transfer functions, rules of block diagram algebra, reduction of block dia. to obtain closed loop transfer function.

Signal flow graphs : Mason's gain formula **(6 Hours)**

MODULE 3

Steady state operation: Steady state analysis for general block dia. for a control system, steady state characteristics, equilibrium in a system**. (3 hours)**

Transient Response: Transient response and steady state analysis of unit, step input, general operational representation for a differential equation of control system, distinct, repeated and complex conjugate zeros, general form of transient response, Routh's stability criterion for a control system. **(4 hours)**

Root Locus Plots : Root locus method: Significance of Root locus, angle and magnitude conditions, breakaway points, angles of departure and arrival, construction of Root locus using general rules and steps, Lead and Lag compensation **(6 Hours)**

MODULE 4

Frequency Domain Analysis: Relationship between time and frequency response, Polar plot, Bode's Plot, Nyquist plot and Nyquist stability criterion, Relative Stability, Phase and Gain Margins **(14 Hours)**

MODULE 5

System Compensation and State Variable Characteristics of Linear Systems : Series and feedback compensation, Introduction to state concepts, state equation of linear continuous data system. Matrix representation of state equations, controllability and observability, Kalmanand Gilberts test .

(**7 Hours)**

Course Outcomes
CO1: Recognize control system and its types , control actions
CO2: Determine the system governing equations for physical models(Electrical, Thermal, Mechanical, Electro Mechanical)
CO3: Calculate the gain of the system using block diagram and signal flow graph
CO4: Illustrate the response of 1st and 2nd order systems
CO5: Determine the stability of transfer functions in complex domain and frequency domain
CO6: Employ state equations to study the controllability and observability

DESIGN OF THERMAL EQUIPMENTS

Course	Code	Credits	L-T-P	Assessment		Exam Duration
				SEE	CIA	
Design of thermal Equipments	15ME741	03	3-0-0	80	20	3Hrs

Course objectives :

1. To understand types of heat exchanger
2. To study the design shell and tube heat exchanger
3. To study types and design of steam heat condenser and compact heat exchanger
4. To comprehend and design air cooled heat exchanger
5. To understand and to design air cooled heat exchanger, furnaces

Module I

Introduction To Heat Exchanger Design: Types of heat exchangers and their applications. Flow arrangements and temperature distributions in transfer type of heat exchangers. Overall heat transfer coefficient;- Clean overall heat transfer coefficient, dirt factor dirt overall heat transfer coefficient, dirt factors for various process services.

Double Pipe Heat Exchangers: Film coefficients for tubes and annuli, equivalent diameter of annuli, fouling factors, caloric or average fluid temperature, true temperature difference; Design calculation of double pipe heat exchanger, double pipe exchangers in series-parallel arrangements.**08 Hrs**

Module II

Shell and tube heat exchangers - tube layouts, baffle spacing, classification of shell and tube exchangers, Design calculation of shell and tube heat exchangers, flow assignments: tube side flow area calculations; viscosity correction factor, shell side equivalent diameter, calculation of shell side heat transfer coefficient, evaluation for wall temperature, evaluation of overall heat transfer coefficient, Calculation of surface area. Calculations of tube side and shell side pressure drops. **08 Hrs**

Module III

Steam Condensers: Specifications of other details as per TEMA standards. Flow arrangement for increased heat recovery: - lack of heat recovery in 1-2 exchangers true temperature difference in a 2-4 exchanger. Calculationprocedure for steam condensers.

Compact Heat Exchangers: Introduction; definition of Geometric Terms: plate fin surface geometries and surface performance data; correlation of heat transfer and friction data; Goodness factor comparisons; specification ofrating and sizing problems; calculation procedure for a rating problem.**08 Hrs**

Module IV

Air-Cooled Heat Exchangers: Air as coolant for industrial processes; custom-built units; fin-tube systems for air coolers; fin-tube bundles; thermal rating; tube side flow arrangements; cooling air supply by fans; cooling airsupply in natural draft towers.

Furnaces And Combustion Chambers: Introduction; process heaters and boiler; heat transfer in furnaces: - Heat source; Heat sink; refractory surfaces; heat transfer to the sink; Design methods: - Method of Lobo and Evans:Method of Wilson, Lobo and Hottel; The Orrok-Hudson equation;Wallenberg simplified method. **08 Hrs**

Module V

Heat pipes - types and applications, operating principles, working fluids, wick structures, control techniques, pressure balance, maximum capillary pressure, liquid and vapor pressure drops, effective thermal conductivity of wick structures, capillary limitation on heat transport capability, sonic, entrainment, and boiling limitations, determination of operating conditions; Heat pipe design – fluid selection, wick selection, material selection, preliminary design considerations, heat pipe design procedure, determination of heat pipe diameter, design of heat pipe containers, wick design, entertainment and boiling limitations, design problems **08 Hrs**

Course outcomes:

1. To have complete knowledge of heat exchanger and its applications
2. To be able to design shell and tube heat exchanger
3. To be able to select and design of steam heat condenser and compact heat exchanger condenser and heat pipes for various application

TEXT BOOKS:

1. **Process Heat Transfer**: Donald Q. Kern, Tata McGraw –Hill Edition (1997)
2. **Compact Heat Exchangers:** W. M. Kays & A. L. London, McGraw –Hill co. (1997)
3. **Heat Pipe Theory and Practice** Chi, S. W., - A Source Book, McGraw-Hill, 1976

REFERENCE BOOKS:

1. **Heat Transfer – A Basic Approach:** NecatiOzsisik, McGraw – Hill International edition (1985).
2. **Heat Exchanger Design Hand Book:** Volumes 2 and 3, edited by Ernst U schlunder. et. al Hemisphere Publishing Co. (1983)
3. **Heat exchanger-** Kokac Thermal- hydraulic and design analysis.
4. **Heat Pipes** Dunn, P. D. and Reay, D. A., , Fourth Edition, Pergamon Press, 1994

TRIBOLOGY

Course	Code	Credits	L-T-P	Assessment		Exam Duration
				SEE	CIA	
Tribology	15ME742	03	3-0-0	80	20	3Hrs

Course objectives:

CLO1	To educate the students on theimportance of friction, the related theories/laws of sliding and rolling friction and the effect of viscosity of lubricants.
CLO2	To expose the students to the consequences of wear, wear mechanisms, wear theories and analysis of wear problems.
CLO3	Tomake the students understand the principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.
CLO4	To expose the students to the factors influencing the selection of bearing materials fordifferent sliding applications.
CLO5	To introduce the concepts of surface engineering and its importance in tribology.

Module 1

Introduction to tribology: Historical background, practical importance, and subsequent use in the field.

Lubricants: Types and specific field of applications. Properties of lubricants,viscosity, its measurement, effect of temperature and pressure on viscosity, lubrication types, standard grades of lubricants, and selection of lubricants.

8 hours

Module 2

Friction: Origin, friction theories, measurement methods, friction of metals and non-metals.

Wear: Classification and mechanisms of wear, delamination theory, debris analysis, testing methods and standards. Related case studies.

8 hours

Module3

Hydrodynamic journal bearings: Friction forces and power loss in a lightly loaded journal bearing, Petroff's equation, mechanism of pressure development in an oil film, and Reynold's equation in 2D.

Introduction to idealized journal bearing, load carrying capacity, condition for equilibrium, Sommerfeld's number and it'ssignificance;partial bearings, end leakages in journal bearing, numerical examples on full journal bearings only.

10 hours

Module4

Plane slider bearings with fixed/pivoted shoe: Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a fixed/pivoted shoe bearing,center of pressure, numerical examples.

Hydrostatic Lubrication: Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing, numerical examples.

8 hours

Module5

Bearing Materials: Commonly used bearings materials, and properties of typical bearing materials. Advantages and disadvantages of bearing materials.

Introduction to Surface engineering: Concept and scope of surface engineering.

Surface modification – transformation hardening, surface melting, thermo chemical processes.

Surface Coating – plating,fusionprocesses, vapor phase processes.

Selection of coating for wear and corrosion resistance.

8 hours

COURSE OUTCOMES:

After studying this course, students will be able to:

CO1	Understand the fundamentals of tribology and associated parameters.
CO2	Apply concepts of tribology for the performance analysis and design of components experiencing relative motion.
CO3	Analyse the requirements and design hydrodynamic journal and plane slider bearings for a given application.
CO4	Select proper bearing materials and lubricants for a given tribological application.
CO5	Apply the principles of surface engineering for different applications of tribology.

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

Use of approved Design Data Handbook/charts can be permitted during the examination.

TEXTBOOKS:

1.”Introduction to Tribology”, B. Bhushan, John Wiley & Sons, Inc., New York, 2002

2. “Engineering Tribology”, Prasanta Sahoo, PHI Learning Private Ltd, New Delhi, 2011. 3.“Engineering Tribology”, J. A. Williams, Oxford Univ. Press, 2005.

REFERENCES:

1. “Introduction to Tribology in bearings”, B. C. Majumdar, Wheeler Publishing.
2. “Tribology, Friction and Wear of Engineering Material”, I. M.Hutchings, Edward Arnold, London,1992.
3. “Engineering Tribology”, G. W. Stachowiak and A. W. Batchelor, Butterworth-Heinemann,1992.
4. “Friction and Wear of Materials”, Ernest Rabinowicz, John Wiley & sons,1995.
5. “Basic Lubrication Theory”, A. Cameron, Ellis Hardwoods Ltd., UK.
6. “Handbook of tribology: materials, coatings and surface treatments”, B.Bhushan, B.K. Gupta, McGraw-Hill,1997.

FINANCIAL MANAGEMENT

Course	Code	Credits	L-T-P	Assessment		Exam Duration
				SEE	CIA	
Financial Management	15ME743	03	3-0-0	80	20	3Hrs

Subject Overview: Finance is the lifeblood of any enterprise. Financial Management is imperative for efficient utilization and generation of monetary resources and funds. The subject deals with fundamental books and records of accounts with financial analysis. The subject imparts expose to statutory levies to strengthen the understanding of government taxed and duties including the general sales tax structure. The subject includes concepts of market risks and returns to efficiently manage the cash and circumvent liquidity problems both at the individual and organizational levels. In the new CBCS scheme, topics on investment decisions and asset management decisions besides the financing decisions. The curriculum also includes costing and budgeting to enable budding engineers to make a comparative study of finance and economics and evaluate costs and revenues of engineering operations.

MODULE - 1

INTRODUCTION: Book keeping – systems of book keeping, journal an d ledger posting. Financial Statement, Preparation of Trial balance, profit and Loss Account, Balance Sheet with adjustments.

05HoursSTATUTORY LEVIES: Forms of organization, direct and indirect taxes. Statutory Registration- excise Duty, central sales tax, VAT, service tax, central and state general Sales tax, international fund availability.

05 Hours

MODULE - 2

WORKING CAPITAL MANAGEMENT: Definition, need and factors influencing the working capital requirement. Determination of operating cycle, cash cycle and operating cycle analysis. Calculation of gross working capital and net working capital requirement.

06 Hours

LONG TERM FINANCING: Raising of finance from primary and secondary markets. Valuation of securities, features of convertible securities and warrants. Features of debt, types of debt instruments, return on investment(ROI) and credit rating of units. Shares, debentures.

06 Hours

MODULE-3

INVESTMENT DECISIONS: Inventory investment , Strategic investment , Ownership investments , lending investment, cash equivalent investment, factors affecting investment decisions, Capital Budgeting, disinvestment methods - public offer, sale of equity, cross holding

06 Hours

ASSET MANAGEMENT DECISIONS : Current Asset Management , Fixed Asset Management, Wealth management , engineering asset management (EAM) - asset maintenance technologies, asset reliability management, project management

06 Hours

MODULE -4

RISK AND REQUIRED RETURN: Risk and return relationship, methods of measuring the risk, Business risk, financial risk, calculation of expected rate of return to the portfolio, financial theories - portfolio theory , capital asset pricing model , arbitage pricing theorynumerical problems. **06 Hours**

RATIO ANALYSIS / ACCOUNTING RATIO: Liquidity ratio – Current ratio, quick ratio, turn over ratio, capital structure ratio- Debt – equity ratio, Coverage ratio, Profitability ratio, Profit margin, Return on assets, Activity ratios – Invento ry turnover ratio, Debtors Turnover ratio. Preparation of the balance sheet from various ratios. Analysis of any one published balanced sheet.

07 Hours

MODULE - 5

COSTING: Classification of costs, preparation of cost sheet, absorption and variable costing, standard costing, job costing, process costing. Classification of the variances analysis – material , labor and overhead variances.

06 Hours

BUDGETING: Types of budgets – Flexible budgets, preparation of cash budgets, purchase and production budgets and master budget, Budgetary control, advantages & limitations of budgeting.

06 Hours

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

1. Measure the returns from engineering projects of differing risks and present a risk-return tradeoff relationship (PO 4, 12)
2. Determine the financial ratios and profitability margins of projects to evaluate economic viability to accept or reject the project. (PO 11)
3. Evaluate cost break ups of engineering projects and processes to determine and control the prohibitive cost components (PO 11)
4. Apply a Engineering Asset Management techniques to evaluate the economic value of physical assets. (PO 1, 11, 12)

TEXTBOOKS:

1. **Financial Management,** Khan & Jain, text & problems TMH ISBN 0-07-460208-A. 20001
2. **Financial Accounting, Costing and Management Accounting,** S. M. Maheshwari, 2000
3. **Srivatsava, Radhey Mohan, Financial Decision Making** : Text Problem and Cases, New Delhi : Sterling Publishers (Private) Limited, 198*, p»H
4. Francis, Pitt, The Foundations of Financial Management, London : Arnold Heinmann, 1983, p.l

REFERENCE BOOKS:

2. **Financial Management,** I. M. Pandey, Vikas Publication House ISBN 0-7069-5435-1. 2002
3. **Financial Management,** Abrish Gupta, Pearson.
4. **Financial Decision Making,**Humpton. 2000
5. **Financial Management,** Theory and Practice, Prasanna Chandra TMH ISGN -07-462047-9, 3rd edition 2002
6. **Essentials of Financial Management**, Walker, Ernest W., New Delhi : Prentice Hall of India Pvt. Ltd, 1976, p.l

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

1. Measure the returns from engineering projects of differing risks and present a risk-return tradeoff relationship (PO 4, 12)
2. Determine the financial ratios and profitability margins of projects to evaluate economic viability to accept or reject the project. (PO 11)
3. Evaluate cost break ups of engineering projects and processes to determine and control the prohibitive cost components (PO 11)
4. Apply a Engineering Asset Management techniques to evaluate the economic value of physical assets. (PO 1, 11, 12)

Design for Manufacturing

Course	Code	Credits	L-T-P	Assessment		Exam Duration
				SEE	CIA	
Design for Manufacturing	15ME744	03	3-0-0	80	20	3Hrs

Course objectives:

CLO1	To educate students on factors to be considered in designing parts and components with focus on manufacturability.
CLO2	To expose the students to dimensional tolerances, geometric tolerances and true position tolerance techniques in manufacture.
CLO3	To impart the knowledge on design considerations for designing components produced using various machining operations like turning, drilling, milling, grinding etc.
CLO4	To educate the students on design rules and recommendations for processes like casting, welding, forgings powder metallurgy and injection moulding.

Module 1:

Major phases of design, effect of material properties on design, effect of manufacturing processes on design. Material selection process- cost per unit property, weighted properties and limits on properties methods. Guidelines for design for manufacturability.

Review of relationship between attainable tolerance grades and different machining processes.Processcapability,mean, variance, skewness, kurtosis, process capability indices- Cp, and Cpk.

Cumulative effect of tolerance- Sure fit law and truncated normal law, problems.

8 hours

Module 2:

Selective Assembly: Interchangeable part manufacture and selective assembly. Deciding the number of groups -model-1: group tolerance of mating parts equal, model- 2: total and group tolerances of shaft equal. Control of axial play- introducing secondary machining operations, and laminated shims; examples.

True positional theory: Comparison between coordinate and true position method offeature location. True position tolerance- virtual size concept, floating and fixed fasteners, projected tolerance zone and functional gages. Concept of Zero true position tolerance. Simple problems on true position tolerancing.

10 hours

Module3:

Datum Features: Functional datum, datum for manufacturing, changing the datum;examples.

Component Design: Design features to facilitate machining: drills, milling cutters, keyways, Doweling procedures, counter sunk screws, Reduction of machined area, simplification by separation, simplification by amalgamation, Design for machinability, Design for economy, Design for clampability, Design for accessibility. Design for assembly

8 hours

Module4:

Design of components with casting considerations: Pattern, mould, and parting line. Cored holes and machined holes. Identifying the possibleand probable parting lines. Castings requiring special sand cores. Designing to obviatesand cores.
Welding considerations: requirements and rules, redesign of components for welding; case studies.

8 hours

Module5:

Forging considerations -requirements and rules-redesign of components for forging and case studies.
Design of components for powder metallurgy- requirements and rules-case studies.
Design of components for injection moulding- requirements and rules-case studies.

8 hours

COURSE OUTCOMES:

After studying this course, students will be able to:

CO1	Describe the different types of manufacturing systems and comparetheir suitability foreconomic production of various components and products.
CO2	Identify factors and causing mechanisms of the defects likely to occur with different manufacturing processes in producing mechanical products and the relevant design approaches to rectify them.
CO3	Select proper materials and manufacturing processes for designing products/components by applying the relevant principles for ease and economic production.
CO4	

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

TEXTBOOKS:

1. Peck, H. “Designing for Manufacture”, Pitman Publications, London, 1983.
2. Dieter, G.E. “Engineering Design: A Materials and processing Approach”, McGraw Hill Co.Ltd, 2000.
3. Bralla, James G., “Handbook of Products Designfor Manufacturing: A Practical Guide to Low-cost Production”, McGraw Hill, New York, 1986.

REFERENCES:

1. Eggert, R.J. “Engineering Design” Pearson Education, Inc., New Jersey, 2005.
2. Matousek , R. “Engineering Design”, Blackie and Son Limited, Glasgow, 1967.
3. Kalandar Saheb, S.D and Prabhakar, O. “Engineering Design for Manufacture”,ISPE 1999.
4. Trucks, H.E., “Design for Economical Production”, 2^{nd}ed., Mich., Dearborn, SME 1987.
5. Linberg, Roy A., “Processes and Materials of Manufacture”, 4^{th}ed., Allyn and Bacon, Boston, U.S.A., 1990.

SMART MATERIALS and MEMS

Course	Code	Credits	L-T-P	Assessment		Exam Duration
				SEE	CIA	
Smart Materials and MEMS	15ME745	03	3-0-0	80	20	3Hrs

Course Objective:

This course provides a detailed overview to smart materials, piezoelectric materials structures and its characteristics. The study of Smart structures and modelling helps in Vibration control using smart materials in various applications. Helps to understand the principles and concepts of using MEMS, ER & MR Fluids for various applications.

MODULE 1

Unit1: Introduction: Closed loop and Open loop Smart Structures. Applications of Smart structures, Piezoelectric properties. Inchworm Linear motor, Shape memory alloys, Shape memory effect-Application, Processing and characteristics.

– 5hrs

Unit 2: Shape Memory Alloys: Introduction, Phenomenology, Influence of stress on characteristic temperatures, Modelling of shape memory effect. Vibration control through shape memory alloys. Design considerations, multiplexing embedded NiTiNOL actuators.

– 5hrs

MODULE -2

Unit-3 Electro rheological and Magneto rheological Fluids:Mechanisms and Properties, Characteristics,Fluid composition and behaviour, Discovery and Early developments, Summary of material properties. Applicationsof ER and MR fluids (Clutches, Dampers, others).

– 5hrs

Unit-4FibreOptics: Introduction, Physical Phenomenon, Characteristics, Fibre optic strain sensors, Twisted and Braided Fibre Optic sensors, Optical fibres as load bearing elements, Crack detection applications, Integration of Fibre optic sensors and shape memory elements. – 5hrs

MODULE-3

Unit 5: Vibration Absorbers: Introduction, Parallel Damped Vibration Absorber, Analysis, Gyroscopic Vibration absorbers, analysis & experimental set up and observations, Active Vibration absorbers. Control of Structures: Introduction, Structures as control plants, Modelling structures for control, Control strategies and Limitations.

– 6hrs

Unit 6: Biomimetics: Characteristics of Natural structures. Fibre reinforced: organic matrix natural composites, Natural creamers, Mollusks. Biomimetic sensing, Challenges and oppurtunities.

– 5hrs

MODULE -4

Unit7: MEMS:History of MEMS, Intrinsic Characteristics, Devices: Sensors and Actuators. Microfabrication: Photolithography, Thermal oxidation, Thin film deposition, etching types, Doping, Dicing, Bonding. Microelectronics fabrication process flow, Silicon based, Process selection and design.

– 5hrs

Unit 8: Piezoelectric Sensing and Actuation: Introduction, Cantilever Piezoelectric actuator model, Properties of Piezoelectric materials, Applications. Magnetic Actuation: Concepts and Principles, Magnetization and Nomenclatures, Fabrication and case studies,Comparison of major sensing and actuation methods.

– 5hrs

MODULE-5

Unit 9: Polymer MEMS&Microfluidics:Introduction, Polymers in MEMS(Polyimide, SU-8,LCP,PDMS,PMMA,Parylene, Others) Applications(Acceleration, Pressure, Flow, Tactile sensors). Motivation for micro fluidics, Biological Concepts, Design and Fabrication of Selective components. Channels and Valves.

– 6hrs

Unit 10: Case Studies: MEMS Magnetic actuators, BP sensors, Microphone, Acceleration sensors, Gyro, MEMS Product development: Performance, Accuracy, Repeatability, Reliability, Managing cost, Market uncertainties, Investment and competition

. – 5hrs

TEXT BOOKS:

1.“Smart Structures –Analysis and Design”, A.V.Srin ivasan, Cambridge University Press, New York, 2001, (ISBN:0521650267).
2. “Smart Materials and Structures”, M.V.Gandhi and B.S.Thompson Chapmen & Hall, London, 1992 (ISBN:0412370107)
3. “Foundation of MEMS, by Chang Liu. Pearson Educa tion. (ISBN:9788131764756)

COURSE OUTCOMES:

1. Describe the methods of controlling vibration using smart systems and fabrication methods of MEMS.
2. Explain the principle concepts of Smart materials, structures, Fibre optics, ER & MR Fluids, Biomimetics and MEMS with principles of working.
3. Analyze the properties of smart structures, MEMS, with the applications and select suitable procedure for fabrication.
4. Summarize the methods and uses of Micro fabrications, Biomimetics, types of polymers used in MEMS, Fibre optics, piezoelectric sensing and actuation.

Automotive Electronics

Course	Code	Credits	L-T-P	Assessment		Exam Duration
				SEE	CIA	
Automotive Electronics	15ME751	03	3-0-0	80	20	3Hrs

Course Objective

Students will learn

1. Basics of electronic control of internal combustion engines and the drives
2. Understand principle of working of sensors and actuators used in automobiles for control
3. Diagnostics and safety systems in automobiles

Module 1

Automotive Fundamentals Overview –Evolution of Automotive Electronics,

Automobile Physical Configuration, Survey of Major Automotive Systems, The Engine – Engine Block, Cylinder Head, Four Stroke Cycle, Engine Control,

Ignition System - Spark plug, High voltage circuit and distribution, Spark pulse generation, Ignition Timing, Diesel Engine, Drive Train - Transmission,

Drive Shaft, Differential, Suspension, Brakes, Steering System\, Starter Battery –Operating principle: (

7 hours

The Basics of Electronic Engine Control – Motivation for Electronic EngineControl – Exhaust Emissions, Fuel Economy, Concept of an Electronic Engine control system, Definition of General terms, Definition of Engine performance terms, Engine mapping, Effect of Air/Fuel ratio, spark timing and EGR on performance, Control Strategy, Electronic Fuel control system,

Analysis of intake manifold pressure, Electronic Ignition.

6 hours

Module 2

Control Systems - Automotive Control System applications of Sensors and Actuators – Typical Electronic Engine Control System, Variables to be measured

3 hours

Automotive Sensors –Airflow rate sensor, Strain Gauge MAP sensor, Engine

Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (O2/EGO) Lambda Sensors, Piezoelectric Knock Sensor.

5 hours

Automotive Actuators – Solenoid, Fuel Injector, EGR Actuator, Ignition System

3 hours

Module 3

Digital Engine Control Systems – Digital Engine control features, Controlmodes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control - Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System - Secondary Air Management, Evaporative

Emissions Canister Purge, Automatic System Adjustment, System Diagnostics.

6 hours

Control Units – Operating conditions, Design, Data processing,Programming, Digital modules in the Control unit, Control unit software.

3 hours

Module 4

Automotive Networking –Bus Systems–Classification, Applications in thevehicle, Coupling of networks, Examples of networked vehicles (Text 2: Pg. 85-91), Buses - CAN Bus, LIN Bus, MOST Bus, Bluetooth, FlexRay, Diagnostic Interfaces. **6 hours**

Vehicle Motion Control –Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock

Brake System (ABS) **3 hours**

Module 5

Automotive Diagnostics–Timing Light, Engine Analyzer, On-boarddiagnostics, Off-board diagnostics, Expert Systems, Occupant Protection
Systems – Accelerometer based Air Bag systems.

4hours

Future Automotive Electronic Systems –Alternative Fuel Engines, Electricand Hybrid vehicles, Fuel cell powered cars, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Heads Up display,
Speech Synthesis, Navigation – Navigation Sensors - Radio Navigation,Signpost navigation, dead reckoning navigation, Voice Recognition Cell Phone dialing, Advanced Cruise Control, Stability Augmentation, Automatic driving Control

6 hours

Course Outcomes

1. Explain the electronics systems used for control of automobiles
2. Select sensors, actuators and control systems used in automobiles
3. Diagnose the faults in the sub systems and systems used automobile

Text Books:

1. William B.Ribbens, "Understanding Automotive El ectronics", 6th Edition, Elsevier Publishing.

2. Robert Bosch Gmbh (Ed.) Bosch Automotive Electrics and AutomotiveElectronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley& Sons Inc., 2007.

FRACTURE MECHANICS

Course	Code	Credits	L-T-P	Assessment		Exam Duration
				SEE	CIA	
Fracture Mechanics	15ME752	03	3-0-0	80	20	3Hrs

Course Objective:

Fracture mechanics provides a methodology for prediction, prevention and control of fracture in materials, components and structures.
It provides a background for damage tolerant design.
It quantifies toughness as materials resistance to crack propagation.

Course Content:

Module 1.
Fracture mechanics principles: Introduction and historical review, Sources of micro and macro cracks. Stress concentration due to elliptical hole, Strength ideal materials, and Griffith's energy balance approach. Fracture mechanics approach to design, NDT andVarious NDT methods used in fracture mechanics, Numerical problems. The Airy stress function. Effect of finitecracksize. Elliptical cracks, Numerical problems.
10Hrs

Module 2.
Plasticity effects: Irwin plastic zone correction. Dugdale's approach . The shape of the plastic zone for plane stress and plane strain cases.Theplate thickness effect, numerical problems.Determination of Stress intensity factors and plane strain fracture toughness: Introduction, estimation of stress intensity factors. Experimental method- Plane strain fracture toughness test, The Standard test,sizerequirements,etc. **08 Hrs**

Module 3.
The energy release rate, Criteria for crack growth. The crack resistance(R curve). Compliance.Tearingmodulus.Stability.
Elastic plastic fracture mechanics: Fracture beyond general yield. The Crack-tip opening displacement. The Use of CTOD criteria. Experimental determination of CTOD. Parameters affecting the critical CTOD.
08Hrs

Module 4.
J integral: Use of J integral. Limitation of J integral. Experimental determination of J integral and the parameters affecting J integral.
Dynamics and crack arrest: Crack speed and kinetic energy. Dynamic stress intensity and elastic energy release rate. Crackbranching. Principles of crack arrest. Crack arrest in practice. Dynamic fracture toughness**.** **08 Hrs**

Module 5.

Fatigue crack propagation and applications of fracture mechanics: Crack growth and the stress intensity factor. Factors affecting crack propagation. Variable amplitude service loading, Means to provide fail-safety, Paris law, Required information for fracture mechanics approach, **08 Hrs**

Course Outcome:

At the end of the course students will:

1. Develop basic fundamental understanding of the effects of cracklike defects on the performance of aerospace, civil, and mechanical Engineering structures.
2. Learn to select appropriate materials for engineering structures to insure damage tolerance.
3. Learn to employ modern numerical methods to determine critical crack sizes and fatigue crack propagation rates in engineering structures.
4. Gain an appreciation of the status of academic research in field of fracture mechanics.

Text Books

1. Elements of Fracture Mechanics by Prasant Kumar, Mc Graw Hill Education, 2009 Edition
2. Anderson , "Fracture Mechanics-Fundamental and A pplication", T.L CRC press1998.
3. David Broek, "Elementary Engineering Fracture Me chanics", Springer Netherlands,2011

Reference Books

1. Karen Hellan , "Introduction to fracture mechani cs", McGraw Hill, 2 nd Edition
2. S.A. Meguid , "Engineering fracture mechanics" E lsevier Applied Science, 1989
3. Jayatilaka, "Fracture of Engineering Brittle Mat erials", Applied Science Publishers, 1979
4. Rolfe and Barsom , "Fracture and Fatigue Control in Structures" , Prentice Hall, 1977
5. Knott , "Fundamentals of fracture mechanisms", B utterworths, 1973

MECHATRONICS

Course	Code	Credits	L-T-P	Assessment		Exam Duration
				SEE	CIA	
Mechatronics	15ME753	03	3-0-0	80	20	3 Hrs

Course objectives:

1. Understand the evolution and development of Mechatronics as a discipline.
2. Substantiate the need for interdisciplinary study in technology education.
3. Understand the applications of microprocessors in various systems and to know the functions of each element
4. Demonstrate the integration philosophy in view of Mechatronics technology

MODULE -1

Introduction: Definition, Multidisciplinary Scenario, Evolution of Mechatronics,Design of Mechatronics system, Objectives, advantages and disadvantages ofMechatronics.

Transducers and sensors: Definition and classification of transducers, Differencebetween transducer and sensor, Definition and classification of sensors, Principleof working and applications of light sensors, proximity switches and Hall Effectsensors. 10 Hours

MODULE -2

Microprocessor &Microcontrollers: Introduction, Microprocessor systems,Basic elements of control systems, Microcontrollers, Difference betweenMicroprocessor and Microcontrollers.

Microprocessor Architecture: Microprocessor architecture and terminology-CPU,memory and address, I/O and Peripheral devices, ALU, Instruction andProgram, Assembler, Data, Registers, Program Counter, Flags, Fetch cycle, writecycle, state, bus interrupts. Intel's 8085A Microprocessor. 10 Hours

MODULE -3

Programmable logic controller: Introduction to PLC's, basic structure, Principleof operation, Programming and concept of ladder diagram, concept of latching &selection of a PLC.

Integration: Introduction & background, Advanced actuators, Pneumaticactuators, Industrial Robot, different parts of a Robot-Controller, Drive, Arm, EndEffectors, Sensor & Functional requirements of robot. 10 Hours

MODULE -4

Mechanical actuation systems: Mechanical systems, types of motion, Cams, Gear trains, Ratchet & Pawl, belt and chain drives, mechanical aspects of motorselection.

Electrical actuation systems: Electrical systems, Mechanical switches, Solenoids,Relays, DC/AC Motors, Principle of Stepper Motors & servomotors.

10 Hours

MODULE -5

Pneumatic and hydraulic actuation systems: Actuating systems, Pneumatic andhydraulic systems, Classifications of Valves, Pressure relief valves, Pressureregulating/reducing valves, Cylinders and rotary actuators.

DCV & FCV: Principle & construction details, types of sliding spool valve, solenoid operated, Symbols of hydraulic elements, components of hydraulicsystem, functions of various units of hydraulic system. Design of simple hydrauliccircuits for various applications. 10 Hours

Course outcomes:

On completion of this subject, students will be able to:

1. Illustrate various components of Mechatronics systems.
2. Assess various control systems used in automation.
3. Develop mechanical, hydraulic, pneumatic and electrical control systems.

TEXT BOOKS:

1. NitaigourPremchandMahalik , Mechatronics-Principles, Concepts and Applications, Tata McGraw Hill, 1stEdition, 2003 ISBN.No. 0071239243, 9780071239240.
2. W.Bolton-Pearson Education, Mechatronics – Elect ronic Control Systems in Mechanicaland Electrical Engineering, 1stEdition, 2005 ISBN No. 81-7758-284-4.

REFERENCE BOOKS:

1. Mechatronics by HMT Ltd. – Tata McGrawHill, 1 st Edition, 2000. ISBN:9780074636435.
2. Anthony Esposito, Fluid Power , Pearson Education, 6th Edition, 2011, ISBN No.9789332518544.

E- Learning

- VTU, E- learning

Scheme of Examination:

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

ADVANCED VIBRATIONS

Course	Code	Credits	L-T-P	Assessment		Exam Duration
				SEE	CIA	
Mechanical Vibrations	15ME754	03	3-0-0	80	20	3 Hrs

Course objectives:

1. To enable the students to understand the theoretical principles of vibration and vibration analysis techniques for the practical solution of vibration problems.
2. To enable the studentsto understand the importance of vibrations in mechanical design of machine parts subject to vibrations.

MODULE -1

Forced vibrations (1DOF): Introduction, analysis of forced vibration with constant harmonic excitation, MF, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, energy dissipated due to damping and numerical problems.

Systems with 2DOF: Principal modes of vibrations, normal mode and natural frequencies of systems (Damping is not included), simple spring-mass systems, masses on tightly stretched strings, double pendulum, tensional systems, combined rectilinear and angular systems, geared systems and numerical problems. 10 Hours

MODULE -2

Numerical methods for multi DOF systems: Maxwell's reciprocal theorem, influence coefficients, Rayleigh's method, Dunkerley's method, stodola method, orthogonality principle, method of matrix iteration and numerical.

Modal analysis and condition monitoring: signal analysis, dynamic testing of machines and structures, experimental modal analysis, machine condition monitoring and diagnosis.10 Hours

MODULE -3

Vibration measuring instruments and whirling of shafts: seismic instruments, vibrometers, accelerometer, frequency measuring instruments and numerical. Whirling of shafts with and without damping.

Vibration Control: Introduction, Vibration isolation theory, Vibration isolation and motion isolation for harmonic excitation, practical aspects of vibration analysis, vibration isolation, Dynamic vibration absorbers and Vibration dampers. 10 Hours

MODULE -4

Transient Vibration of single Degree-of freedom systems: Impulse excitation, arbitrary excitation, Laplace transforms formulation, Pulse excitation and rise time, Shock response spectrum, Shock isolation.

Random Vibrations: Random phenomena Time averaging and expected value, Frequency response function, Probability distribution, Correlation, Power spectrum and power spectral density, Fourier transforms and response. 10 Hours

MODULE -5

Non Linear Vibrations: Introduction, Sources of nonlinearity, Qualitative analysis of nonlinear systems. Phase plane, Conservative systems, Stability of equilibrium, Method of isoclines, Perturbation method, Method of iteration, Self-excited oscillations.

Continuous Systems: Vibration of string, longitudinal vibration of rods, Torsional vibration of rods, Euler equation for beams.

10 Hours

Course outcomes:

On completion of this subject, students will be able to:

4. Understand and characterize the single and multi degrees of freedom systems subjected to free and forced vibrations with and without damping.
5. Understand the method of vibration measurements and its controlling.
6. Understand the concept of dynamic vibrations of a continuous systems.

TEXT BOOKS:

1. S. S. Rao, "Mechanical Vibrations", Pearson Educ ation.
2. S. Graham Kelly, "Fundamentals of Mechanical Vib ration" - McGraw-Hill.
3. "Theory of Vibration with Application" - William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, 5th edition Pearson Education.
4. "Mechanical Vibrations", V. P. Singh, Dhanpat Ra i & Company.
5. Mechanical Vibrations, W.T. Thomson W.T.- Prentice Hill India

REFERENCE BOOKS:

1. S. Graham Kelly, "Mechanical Vibrations", Schaum 's Outlines, Tata McGraw Hill.
2. C Sujatha, "Vibraitons and Acoustics – Measureme nts and signal analysis", Tata McGraw Hill.
3. "Mechanical Vibrations", G. K. Grover, Nem Chand and Bros.

E- Learning

- VTU, E- learning

Scheme of Examination:

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

DESIGN LABORATORY

Course	Code	Credits	L-T-P	Assessment		Exam Duration
				SEE	CIA	
Design Laboratory	15MEL76	02	1-0-2	80	20	3Hrs

Prerequisites: Knowledge of Dynamics and Machines and Design of Machine Elements

COURSE OBJECTIVES:

Students are expected-

1. To understand the natural frequency, logarithmic decrement, damping ratio and damping.
2. To understand the balancing of rotating masses.
3. To understand the concept of the critical speed of a rotating shaft.
4. To understand the concept of stress concentration using Photo elasticity.
5. To understand the equilibrium speed, sensitiveness, power and effort of Governor.

PART –A

1. Determination of natural frequency, logarithmic decrement, damping ratio and damping Co-efficient in a single degree of freedom vibrating systems (longitudinal and torsional)
2. Determination of critical speed of rotating shaft.
3. Balancing of rotating masses.
4. Determination of fringe constant of Photo-elastic material using Circular disk subjected diametric compression, Pure bending specimen (four point bending)
5. Determination of stress concentration using Photo elasticity for simple components like Plate with hole under tension or bending, circular disk with circular hole under compression, 2-d crane hook.

PART –B

1. Determination of equilibrium speed, sensitiveness, power and effort ofPorter/ Proel / Hartnell Governor. (at least one)
2. Determination of pressure distribution in Journal bearing
3. Determination of principle stresses and strain in a member subjected to combined loading using strain rosettes.
4. Determination of stresses in curved beam using strain gauge.
5. Experiments on Gyroscope (Demonstration only)

COURSE OUTCOMES

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

1. To understand the working principles of machine elements such as Governors, Gyroscopes etc.,
2. To identify forces and couples in rotating mechanical system components.
3. To identify vibrations in machine elements and design appropriate damping methods and to determine the critical speed of a rotating shaft.
4. To measure strain in various machine elements using strain gauges.
5. To determine the minimum film thickness, load carrying capacity, frictional torque and pressure distribution of journal bearing.
6. To determine strain induced in a structural member using the principle of photo-elasticity.

Scheme of Examination:

One question from Part A:	**32 Marks**
One question from part B:	**32 Marks**
Viva- Voce:	**16 Marks**
Total:	**80 Marks**

Reference Books:

[1] "Shigley's Mechanical Engineering Design", Rich ards G. Budynas and J. Keith Nisbett, McGraw-Hill Education, 10th Edition, 2015.

[2] "Design of Machine Elements", V.B. Bhandari, TM H publishing company Ltd. New Delhi, 2nd Edition 2007.

[3] "Theory of Machines", Sadhu Singh, Pearson Educ ation, 2nd Edition, 2007.

[4] "Mechanical Vibrations", G.K. Grover, Nem Chand and Bros, 6th Edition, 1996.

COMPTER INTEGRATED MANUFACTURING LAB

Course	Code	Credits	L-T-P	Assessment		Exam Duration
				SEE	CIA	
Computer Integrated Manufacturing LAB	15MEL77	02	1-0-2	80	20	3Hrs

Course Objectives:

CLO1	To expose the students to the techniques of CNC programming and cutting tool path generation through CNC simulation software by using G-Codes and M-codes.
CLO2	To educate the students on the usage of CAM packages.
CLO3	To make the students understand the importance of automation in industries through exposure to FMS, Robotics, and Hydraulics and Pneumatics.

Part-A

Manual CNC part programming for 2 turning and 2 milling parts.Selection and assignment of tools, correction of syntax and logical errors, and verification of tool path.

CNC part programming using CAM packages. Simulation of Turning, Drilling, Milling operations.

3 typical simulations to be carried out using simulation packages like:**CademCAMLab-Pro, Master- CAM.**

Program generation using software. Optimize spindle power, torque utilization, and cycle time. Generation and printing of shop documents like process and cycle time sheets, tool list, and tool layouts.Cut the part in single block and auto mode and measure the virtual part on screen. Post processing of CNC programs for standard CNC control systems like FANUC, SINUMERIC and MISTUBISHI.

Part B

(Only for Demo/Viva voce)

FMS (Flexible Manufacturing System): Programming of Automatic storage and Retrieval system (ASRS) and linear shuttle conveyor Interfacing CNC lathe, milling with loading unloading arm and ASRS to be carried out on simple components.

(Only for Demo/Viva voce)

Robot programming: Using Teach Pendent & Offline programming to perform pick and place, stacking of objects (2 programs).

Pneumatics and Hydraulics, Electro-Pneumatics: 3 typical experiments on Basics of these topics to be conducted.

Course Outcomes:

After studying this course, students will be able to:

CLO1	Generate CNC Lathe part program for Turning, Facing, Chamfering, Grooving, Step turning, Taper turning, Circular interpolation etc.
CLO2	Generate CNC Mill Part programming for Point to point motions, Line motions, Circular interpolation, Contour motion, Pocket milling- circular, rectangular, Mirror commands etc.
CLO3	Use Canned Cycles for Drilling, Peck drilling, Boring, Tapping, Turning, Facing, Taper turning Thread cutting etc.
CLO4	Simulate Tool Path for different Machining operations of small components using CNC Lathe & CNC Milling Machine.
CLO5	Use high end CAM packages for machining complex parts; use state of art cutting tools and related cutting parameters; optimize cycle time.
CLO6	Understand & write programs for Robotcontrol;understand the operating principles of hydraulics, pneumatics and electropneumatic systems. Apply this knowledge to automate & improve efficiency of manufacturing.

Scheme for Examination:
Two Questions from Part A - 60 Marks (30 +30)
Viva-Voce - 20 Marks
Total: 80 Marks

Project Work, Phase I

Course	Code	Credits	L-T-P	Assessment		Exam Duration
				SEE	CIA	
Project Work, Phase I	15MEP78	2	0-3-0	100	-	-