VISVESVARAYA TECHNOLOGICAL UNIVERSITY BELAGAVI
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION (2017)

B.E. in MECHANICAL ENGINEERING

VII SEMESTER

Sl. No	Subject Code	Title	Teaching Hours /Week			Examination				Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Duration (Hours)	SEE Marks	CIE Marks	Total Marks	
1	17ME71	Energy Engineering	3	2	0	03	60	40	100	4
2	17ME72	Fluid Power Systems	4	0	0	03	60	40	100	4
3	17ME73	Control Engineering	3	2	0	03	60	40	100	4
4	17ME74X	Professional Elective - III	3	0	0	03	60	40	100	3
5	17ME75X	Professional Elective-IV	3	0	0	03	60	40	100	3
6	17MEL76	Design Lab	1	0	2	03	60	40	100	2
7	17MEL77	CIM Lab	1	0	2	03	60	40	100	2
8	17MEP78	Project Phase – I	-	-	03	-	--	100	100	2
TOTAL			**18**	**4**	**07**	**21**	**420**	**380**	**800**	**24**

Professional Elective-III	
17ME741	Design of Thermal Equipment's
17ME742	Tribology
17ME743	Financial Management
17ME744	Design for Manufacturing
17ME745	Smart Materials & MEMS

Professional Elective-IV	
17ME751	Automotive Electronics
17ME752	Fracture Mechanics
17ME753	**Mechatronics**
17ME754	**Advanced Vibrations**

Core subject: This is the course, which is to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study. **Professional Elective:** Elective relevant to chosen specialization/ branch

ENERGY ENGINEERING

B.E, VII Semester, Mechanical Engineering

[As per Choice Based Credit System (CBCS) scheme]

Course Code	**17ME71**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**04**	**SEE Marks**	**60**
Total Number of Lecture Hours	**50(10 Hours per Module)**	**Exam Hours**	**03**
Credits – 04			

Course Objectives:

- **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 - 1

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.

Module - 2

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.

Module - 3

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

Module - 4
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, horizontal land 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.
Module - 5
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 .
Course outcomes: **1. Summarize the basic concepts of thermal energy systems,** **2. Identify renewable energy sources and their utilization.** **3. Understand the basic concepts of solar radiation and analyze the working of solar PV and thermal systems.** **4. Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, biogas.** **5. Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.** **6. 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 Applications and Technologies, Prentice Hall of India, 2009. 3. L.L. Freris, Wind Energy Conversion Systems, Prentice Hall, 1990.

FLUID POWER SYSTEMS
B.E, VII Semester, Mechanical Engineering
[As per Choice Based Credit System (CBCS) scheme]

Course Code	**17ME72**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**04**	**SEE Marks**	**60**
Total Number of Lecture Hours	**50(10 Hours per Module)**	**Exam Hours**	**03**

Credits – 04

Course Objectives:

- **To provide an insight into the capabilities of hydraulic and pneumatic fluid power.**
- **To understand concepts and relationships surrounding force, pressure, energy and power in fluid power systems.**
- **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.**
- **Exposure to build and interpret hydraulic and pneumatic circuits related to industrial applications.**
- **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.

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).

Module - 3

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.

Module - 4

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.

Module - 5

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.

Course outcomes:

1. **Identify and analyse the functional requirements of a fluid power transmission system for a given application.**
2. **Visualize how a hydraulic/pneumatic circuit will work to accomplish the function.**
3. **Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application.**
4. **Select and size the different components of the circuit.**
5. **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,VolI,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.

CONTROL ENGINEERING

B.E, VII Semester, Mechanical Engineering

[As per Choice Based Credit System (CBCS) scheme]

Course Code	**17ME73**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**04**	**SEE Marks**	**60**
Total Number of Lecture Hours	**50(10 Hours per Module)**	**Exam Hours**	**03**

Credits – 04

Course Objectives:

- **Modeling of mechanical, hydraulic, pneumatic and electrical systems.**
- **Representation of system elements by blocks and its reduction**
- **Transient and steady state response analysis of a system.**
- **Frequency response analysis using polar plot.**
- **Frequency response analysis using bode plot.**
- **Analysis of system using root locus plots.**
- **Different system compensators and variable characteristics of linear systems.**

Module - 1

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.

Module - 2

Modeling of Physical Systems : Mathematical Models of Mechanical, Electrical, Thermal, Hydraulic and Pneumatic Systems.

Analogous Systems: Direct and inverse analogs for mechanical, thermal and fluid systems.

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

Module - 3

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

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.

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

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

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.

Course outcomes:

1. **Recognize control system and its types , control actions**
2. **Determine the system governing equations for physical models(Electrical, Thermal, Mechanical, Electro Mechanical)**
3. **Calculate the gain of the system using block diagram and signal flow graph**
4. **Illustrate the response of 1st and 2nd order systems**
5. **Determine the stability of transfer functions in complex domain and frequency domain**
6. **Employ state equations to study the controllability and observability**

TEXT BOOKS:

1. Modern control theory, Katsuhiko Ogata, Pearson Education International , Fifth edition.
2. "Control systems Principles and Design", M.Gopal, 3rd Edition, TMH, 2000.

REFERENCE BOOKS:

3. Control system engineering, Norman S Nise, John Wiley &Sons, Inc., Sixth edition
4. Modern control systems, Richard C. Dorf, Robert H Bishop, Pearson Education International, Twelfth edition.
5. Automatic control systems, Farid Golnaraghi, Benjamin C Kuo, John Wiley & Sons, Inc., Nineth edition
6. J.Nagrath and M.Gopal," Control System Engineering", New Age International Publishers, 5th Edition, 2007
7. "Feedback control systems", Schaum's series, 2001.
8. System dynamics and control, Eronini-Umez, Thomas Asia Pte ltd., Singapore 2002.

DESIGN OF THERMAL EQUIPMENTS

B.E, VII Semester, Mechanical Engineering
[As per Choice Based Credit System (CBCS) scheme]

Course Code	17ME741	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits –03

Course Objectives:

- **To understand types of heat exchanger**
- **To study the design shell and tube heat exchanger**
- **To study types and design of steam heat condenser and compact heat exchanger**
- **To comprehend and design air cooled heat exchanger**
- **To understand and to design air cooled heat exchanger, furnaces**

Module - 1

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.

Module - 2

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.

Module - 3

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.

Module - 4
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.
Module - 5
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
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
B.E, VII Semester, Mechanical Engineering
[As per Choice Based Credit System (CBCS) scheme]

Course Code	**17ME742**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (8 Hours per Module)**	**Exam Hours**	**03**
Credits –03			

Course Objectives:

- **To educate the students on theimportance of friction, the related theories/laws of sliding and rolling friction and the effect of viscosity of lubricants.**
- **To expose the students to the consequences of wear, wear mechanisms, wear theories and analysis of wear problems.**
- **Tomake the students understand the principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.**
- **To expose the students to the factors influencing the selection of bearing materials fordifferent sliding applications.**
- **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.

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.

Module - 3

Hydrodynamic journal bearings: Friction forces and power loss in a lightly loaded journal bearing, Petroff'sequation, 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.

Module - 4

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.

Module - 5

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, vapour phase processes.

Selection of coating for wear and corrosion resistance.

Course outcomes:

1. **Understand the fundamentals of tribology and associated parameters.**
2. **Apply concepts of tribology for the performance analysis and design of components experiencing relative motion.**
3. **Analyse the requirements and design hydrodynamic journal and plane slider bearings for a given application.**
4. **Select proper bearing materials and lubricants for a given tribological application.**
5. **Apply the principles of surface engineering for different applications of tribology.**

TEXT BOOKS:

1. ”Introduction to Tribology”, B. Bhushan, John Wiley & Sons, Inc., New York, 2002
2. “Engineering Tribology”, PrasantaSahoo, PHI Learning Private Ltd, New Delhi, 2011.
3. “Engineering Tribology”, J. A. Williams, Oxford Univ. Press, 2005.

REFERENCE BOOKS

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

B.E, VII Semester, Mechanical Engineering

[As per Choice Based Credit System (CBCS) scheme]

Course Code	17ME743	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits –03

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 and ledger posting. Financial Statement, Preparation of Trial balance, profit and Loss Account, Balance Sheet with adjustments.

STATUTORY 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.

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.

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.

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

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

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.

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

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.

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

Course outcomes:

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)**

TEXT BOOKS:

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*, pH.
4. Francis, Pitt, The Foundations of Financial Management, London : Arnold Heinmann, 1983, p.l

REFERENCE BOOKS:

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

Design for Manufacturing
B.E, VII Semester, Mechanical Engineering
[As per Choice Based Credit System (CBCS) scheme]

Course Code	**17ME744**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per Module)**	**Exam Hours**	**03**
Credits –03			

Course Objective:

- **To educate students on factors to be considered in designing parts and components with focus on manufacturability.**
- **To expose the students to dimensional tolerances, geometric tolerances and true position tolerance techniques in manufacture.**
- **To impart the knowledge on design considerations for designing components produced using various machining operations like turning, drilling, milling, grinding etc.**
- **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-C_p, and C_{pk}.

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

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.

Module - 3

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

Module - 4

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.

Module - 5

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.

Course outcomes:

1. **Describe the different types of manufacturing systems and comparetheir suitability foreconomic production of various components andproducts.**
2. **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.**
3. **Select proper materials and manufacturing processes for designing products/components by applying the relevant principles for ease and economic production.**

TEXT BOOKS:

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.

REFERENCE BOOKS

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

SMART MATERIALS and MEMS

B.E, VII Semester, Mechanical Engineering

[As per Choice Based Credit System (CBCS) scheme]

Course Code	**17ME745**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8Hours per Module)**	**Exam Hours**	**03**
Credits –03			

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

- 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.

- 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.

Module - 2

- 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). – 4hrs
- FibreOptics: 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. – 4hrs

Module - 3

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

Module - 4

- 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.
- 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.

Module - 5

- 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.

- 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

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.**

TEXT BOOKS:

1."Smart Structures –Analysis and Design", A.V.Srinivasan, 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 Education. (ISBN:9788131764756)

REFERENCE BOOKS

1.

Automotive Electronics
B.E, VII Semester, Mechanical Engineering
[As per Choice Based Credit System (CBCS) scheme]

Course Code	**17ME751**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per Module)**	**Exam Hours**	**03**
Credits –03			

Course Objective:

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:

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.

Module - 2

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

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, PiezoelectricKnock Sensor. Automotive Actuators– Solenoid, Fuel Injector, EGR Actuator, Ignition.

Module - 3

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

Module - 4

- 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.
- 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.

Module - 5

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

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 dialling, Advanced Cruise Control, Stability Augmentation, Automatic driving Control.

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. 1William B.Ribbens, “Understanding Automotive Electronics”, 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

B.E, VII Semester, Mechanical Engineering

[As per Choice Based Credit System (CBCS) scheme]

Course Code	**17ME752**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per Module)**	**Exam Hours**	**03**

Credits –03

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.**

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.

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.

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.

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**.**

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,

Course outcomes:

- **Develop basic fundamental understanding of the effects of cracklike defects on the performance of aerospace, civil, and mechanicalEngineering structures.**
- **Learn to select appropriate materials for engineering structures to insure damage tolerance.**
- **Learn to employ modern numerical methods to determine critical crack sizes and fatigue crack propagation rates in engineering structures.**
- **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 Application", T.L CRC press1998.
3. David Broek, "Elementary Engineering Fracture Mechanics", Springer Netherlands,2011

REFERENCE BOOKS

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

MECHATRONICS

B.E, VII Semester, Mechanical Engineering

[As per Choice Based Credit System (CBCS) scheme]

Course Code	**17ME753**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per Module)**	**Exam Hours**	**03**

Credits –03

Course Objective:

- **Understand the evolution and development of Mechatronics as a discipline.**
- **Substantiate the need for interdisciplinary study in technology education.**
- **Understand the applications of microprocessors in various systems and to know the functions of each element**
- **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.

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.

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.

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.

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.

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, 1st Edition, 2003 ISBN.No. 0071239243, 9780071239240.
2. W.Bolton-Pearson Education, Mechatronics – Electronic Control Systems in Mechanicaland Electrical Engineering, 1st Edition, 2005 ISBNNo. 81-7758-284-4.

REFERENCE BOOKS

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

ADVANCED VIBRATIONS

B.E, VII Semester, Mechanical Engineering

[As per Choice Based Credit System (CBCS) scheme]

Course Code	**17ME754**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per Module)**	**Exam Hours**	**03**

Credits –03

Course Objective:

- **To enable the students to understand the theoretical principles of vibration and vibration analysis techniques for the practical solution of vibration problems.**
- **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.

Module - 2

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.

Module - 3

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

Module - 4

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.

Module - 5

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.

Course outcomes:

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

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

TEXT BOOKS:

1. S. S. Rao, "Mechanical Vibrations", Pearson Education.
2. S. Graham Kelly, "Fundamentals of Mechanical Vibration" - McGraw-Hill.
3. "Theory of Vibration with Application" - William T. Thomson, Marie Dillon Dahleh, ChandramouliPadmanabhan, 5th edition Pearson Education.
4. "Mechanical Vibrations", V. P. Singh, DhanpatRai& 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 – Measurements and signal analysis", Tata McGraw Hill.
3. "Mechanical Vibrations", G. K. Grover, Nem Chand and Bros

DESIGN LABORATORY
B.E, VII Semester, Mechanical Engineering
[As per Choice Based Credit System (CBCS) scheme]

Course Code	17MEL76	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03 (1 Hour Instruction+ 2 Hours Laboratory)**	**SEE Marks**	**60**
RBT Levels	**L1, L2, L3**	**Exam Hours**	**03**
Credits –02			

Course Objective:

- **To understand the natural frequency, logarithmic decrement, damping ratio and damping.**
- **To understand the balancing of rotating masses.**
- **To understand the concept of the critical speed of a rotating shaft.**
- **To understand the concept of stress concentration using Photo elasticity.**
- **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:

On completion of this subject, 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.**

REFERENCE BOOKS

[1] "Shigley's Mechanical Engineering Design", Richards G. Budynas and J. Keith Nisbett, McGraw-Hill Education, 10th Edition, 2015.
[2] "Design of Machine Elements", V.B. Bhandari, TMH publishing company Ltd. New Delhi, 2nd Edition 2007.
[3] "Theory of Machines", Sadhu Singh, Pearson Education, 2nd Edition, 2007.
[4] "Mechanical Vibrations", G.K. Grover, Nem Chand and Bros, 6th Edition, 1996.

Scheme of Examination:

One question from Part A:	**50 Marks**
One question from part B:	**30 Marks**
Viva- Voce:	**20Marks**
Total:	**100 Marks**

COMPUTER INTEGRATED MANUFACTURING LAB B.E, VII Semester, Mechanical Engineering [As per Choice Based Credit System (CBCS) scheme]			
Course Code	17MEL77	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03 (1 Hour Instruction+ 2 Hours Laboratory)**	**SEE Marks**	**60**
Total Hours	**40**	**Exam Hours**	**03**
Credits –02			

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 and cut part on virtual CNC machine simulator.
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 oftools, correction of syntax and logical errors, and verification of tool path.

CNC part programming using CAM packages. Simulation of Turning, Drilling, Millingoperations. 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. Enter program, take tool offsets, cut part in single block and auto mode, measure the virtual part on screen in the virtual CNC machine simulator, for standard CNC control systems FANUC, FAGOR, HAAS and SINUMERIK.

Part B

(Only for Demo/Viva voce)

FMS (Flexible Manufacturing System): Programming of Automatic storage and Retrievalsystem (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 thesetopics 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; set up and cut part on.
CLO6	Understand & write programs for Robot control; understand the operating principles of hydraulics, pneumatics and electro pneumatic systems.

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	**17MEP78**	**2**	**0-0-3**		**100**	**-**