### THE UNIVERSITY CHENNAI :: CHENNAI 600 025

### AFFILIATED INSTITUTIONS

### REGULATIONS – 2008

### B.E. MECHANICAL ENGINEERING

### CURRICULUM AND SYLLABUS

#### SEMESTER V

(Applicable to the students admitted from the Academic year 2008 – 2009 onwards)

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Course Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
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<tr>
<td><strong>THEORY</strong></td>
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<tr>
<td>GE 2021</td>
<td>Environmental Science &amp; Engineering</td>
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<td>ME 2303</td>
<td>Design of Machine Elements</td>
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</table>
AIM:

- The aim of this course is to create awareness in every engineering graduate about the importance of environment, the effect of technology on the environment and ecological balance and make them sensitive to the environment problems in every professional Endeavour that they participates.

OBJECTIVE:

- At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity. The role of government and non-government organization in environment managements.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14
Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.
Field study of common plants, insects, birds
Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8
Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.
Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10
Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non
renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.
Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT

UNIT V HUMAN POPULATION AND THE ENVIRONMENT

TOTAL = 45 PERIODS

TEXT BOOKS:

REFERENCES
OBJECTIVE:
- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes
- To apply the thermodynamic concepts into various thermal application like IC engines, Steam Turbines, Compressors and Refrigeration and Air conditioning systems

UNIT I   GAS POWER CYCLES  9
Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure, and air standard efficiency -Actual and theoretical PV diagram of four stroke and two stroke engines

UNIT II   INTERNAL COMBUSTION ENGINES  9
Classification - Components and their function - Valve timing diagram and port timing diagram - Comparison of two stroke and four stroke engines - Carburettor system, Diesel pump and injector system. Performance calculation - Comparison of petrol and diesel engine - Lubrication system and Cooling system - Battery and Magneto Ignition System – Formation of exhaust emission in SI and CI engines

UNIT III  STEAM NOZZLES AND TURBINES  9
Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow, Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations –Governors.

UNIT IV   AIR COMPRESSOR  9
Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling –work of multistage air compressor

UNIT V   REFRIGERATION AND AIR CONDITIONING  9
Vapour compression refrigeration cycle- super heat, sub cooling - Performance calculations - working principle of vapour absorption system, Ammonia –Water, Lithium bromide –water systems (Description only) - Alternate refrigerants - Comparison between vapour compression and absorption systems - Air conditioning system: Types, Working Principles - Psychrometry, Psychrometric chart - Cooling Load calculations - Concept of RSHF, GSHF, ESHF -
(Use of standard thermodynamic tables, Mollier diagram, Psychrometric chart and refrigerant property tables are permitted in the examination)

TOTAL: 60 PERIODS

TEXT BOOKS:
REFERENCES:

ME2302 DYNAMICS OF MACHINERY

OBJECTIVE:
- To understand the method of static force analysis and dynamic force analysis of mechanisms
- To study the undesirable effects of unbalance in rotors and engines.
- To understand the concept of vibratory systems and their analysis
- To understand the principles of governors and gyroscopes.

UNIT I FORCE ANALYSIS AND FLYWHEELS 10

UNIT II BALANCING 9
Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine – Primary and secondary unbalanced forces - Balancing Multi-cylinder Engines – Firing order – Pivoted cradle balancing machines

UNIT III FREE VIBRATION 10
Basic features of vibratory systems - Basic elements and lumping of parameters - Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion - natural frequency - Types of Damping - Damped free vibration – Whirling of shafts and critical speed - Torsional systems; Natural frequency of two and three rotor systems.

UNIT IV FORCED VIBRATION 7
Response to periodic forcing - Harmonic Forcing – Forced vibration caused by unbalance - Support motion – Force transmissibility and amplitude transmissibility - Vibration isolation

UNIT V MECHANISMS FOR CONTROL 9
Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in Automobiles and ships

TUTORIAL: 15 TOTAL: 60 PERIODS
TEXT BOOKS:

REFERENCES

STANDARDS:
1. IS 11717 : 2000, Vocabulary on Vibration and Shock
2. IS 13301 : 1992, Guidelines for vibration isolation for machine foundations
3. IS 10000 : Part 7 : 1980, Methods of tests for internal combustion engines: Part 7 Governing tests for constant speed engines and selection of engines for use with electrical generators
4. IS 13274 : 1992, Mechanical vibration - Balancing – Vocabulary
5. IS 13277 : 1992, Balancing machine - Description and evaluation

ME2303 DESIGN OF MACHINE ELEMENTS L T P C 3 1 0 4

OBJECTIVE:
To familiarise the various steps involved in the Design Process
• To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
• To learn to use standard practices and standard data
• To learn to use catalogues and standard machine components

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS

UNIT II DESIGN OF SHAFTS AND COUPLINGS
Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys, key ways and splines - Design of crankshafts -- Design of rigid and flexible couplings.
UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS
Threaded fastners - Design of bolted joints including eccentric loading, Knuckle joints, Cotter joints – Design of welded joints, riveted joints for structures - theory of bonded joints.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS
Design of various types of springs, optimization of helical springs -- rubber springs -- Design of flywheels considering stresses in rims and arms, for engines and punching machines.

UNIT V DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS
Sliding contact and rolling contact bearings -- Design of hydrodynamic journal bearings, McKee's Eqn., Sommerfield Number, Raimondi & Boyd graphs, -- Selection of Rolling Contact bearings -- Design of Seals and Gaskets -- Design of Connecting Rod.

TUTORIAL: 15 TOTAL: 60 PERIODS

Note: (Use of P S G Design Data Book is permitted in the University examination)

TEXT BOOKS:

REFERENCES:

STANDARDS:
OBJECTIVE:
- To understand the basic principles of measurements
- To learn the various linear and angular measuring equipments, their principle of operation and applications
- To learn about various methods of measuring Mechanical parameters

UNIT I CONCEPT OF MEASUREMENT
General concept – Generalised measurement system-Units and standards-measuring instruments: sensitivity, stability, range, accuracy and precision-static and dynamic response-repeatability-systematic and random errors-correction, calibration - Introduction to Dimensional and Geometric Toleranceing - interchangeability,

UNIT II LINEAR AND ANGULAR MEASUREMENT

UNIT III FORM MEASUREMENT
Measurement of screw threads: Thread gauges, floating carriage micrometer-measurement of gear tooth thickness: constant chord and base tangent method-Gleason gear testing machine – radius measurements-surface finish: equipment and parameters, straightness, flatness and roundness measurements.

UNIT IV LASER AND ADVANCES IN METROLOGY
Precision instruments based on laser-Principles- laser interferometer-application in measurements and machine tool metrology- Coordinate measuring machine (CMM): need, construction, types, applications.- computer aided inspection.

UNIT V MEASUREMENT OF MECHANICAL PARAMETERS
Force, torque, power:-mechanical, pneumatic, hydraulic and electrical type-Pressure measurement - Flow: Venturi, orifice, rotameter, pitot tube- Temperature: bimetallic strip, thermocouples, pyrometer, electrical resistance thermistor.

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES
ME2305 APPLIED HYDRAULICS AND PNEUMATICS

(LT PC)

3 0 0 3

(COMMON TO MECHANICAL AND MECHATRONICS - VI SEMESTER)

OBJECTIVE:

- To know the advantages and applications of Fluid Power Engineering and Power Transmission System.
- To learn the Applications of Fluid Power System in automation of Machine Tools and others Equipments.

UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS 9


UNIT II HYDRAULIC SYSTEM & COMPONENTS 9


UNIT III DESIGN OF HYDRAULIC CIRCUITS 9


UNIT IV PNEUMATIC SYSTEMS AND COMPONENTS 9


UNIT V DESIGN OF PNEUMATIC CIRCUITS 9

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
5. Harry L. Stewart D.B, “Practical guide to fluid power”, Taraokeala sons and Port Ltd.

ME2306 THERMAL ENGINEERING LABORATORY - I

LIST OF EXPERIMENTS

I.C ENGINE LAB AND FUELS LAB

Valve Timing and Port Timing Diagrams.
Performance Test on 4-stroke Diesel Engine.
Heat Balance Test on 4-stroke Diesel Engine.
Morse Test on Multicylinder Petrol Engine.
Retardation Test to find Frictional Power of a Diesel Engine.
Determination of Flash Point and Fire Point.

STEAM LAB

Study of Steam Generators and Turbines.
Performance and Energy Balance Test on a Steam Generator.
Performance and Energy Balance Test on Steam Turbine.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT

(for a batch of 30 students)
I.C Engine – 2 stroke and 4 stroke model 1 set
Red Wood Viscometer 1 No.
Apparatus for Flash and Fire Point 1 No.
4-stroke Diesel Engine with mechanical loading. 1 No.
4-stroke Diesel Engine with hydraulic loading. 1 No.
4-stroke Diesel Engine with electrical loading. 1 No.
Multi-cylinder Petrol Engine 1 No.
Single cylinder Petrol Engine 1 No.
Data Acquisition system with any one of the above engines 1 No.
Steam Boiler with turbine setup 1 No.
OBJECTIVES:

- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To understand how certain measuring devices are used for dynamic testing.

LIST OF EXPERIMENTS

1. a) Study of gear parameters.
   b) Experimental study of velocity ratios of simple, compound, Epicyclic and
differential gear trains.
2. a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker,
   Oscillating cylinder Mechanisms.
   b) Kinematics of single and double universal joints.
3. a) Determination of Mass moment of inertia of Fly wheel and Axle system.
   b) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table
   apparatus.
   c) Determination of Mass Moment of Inertia using bifilar suspension and compound
   pendulum.
4. Motorized gyroscope – Study of gyroscopic effect and couple.
5. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell,
   and Hartnell Governors.
6. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
7. a) Single degree of freedom Spring Mass System – Determination of natural
   Frequency and verification of Laws of springs – Damping coefficient determination.
   b) Multi degree freedom suspension system – Determination of influence coefficient.
8. a) Determination of torsional natural frequency of single and Double Rotor systems.
    Undamped and Damped Natural frequencies.
   b) Vibration Absorber – Tuned vibration absorber.
9. Vibration of Equivalent Spring mass system – undamped and damped vibration.
10. Whirling of shafts – Determination of critical speeds of shafts with concentrated
    loads.
11. a) Balancing of rotating masses. b) Balancing of reciprocating masses.
12. a) Transverse vibration of Free-Free beam – with and without concentrated masses.
    b) Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.
    c) Determination of transmissibility ratio using vibrating table.

Students should be familiar with the use of the following device/equipments depending
upon availability.
Tachometers – Contact and non contact
Dial gauge
Stroboscope
Accelerometers – Vibration pickups
Displacement meters.
Oscilloscope
Vibration Shaker

**LIST OF EQUIPMENT**

(For a batch of 30 students)

1. Cam analyzer.
2. Motorised gyroscope.
5. Dynamic balancing machine.
6. Static and dynamic balancing machine.
7. Vibrating table
8. Vibration test facilities apparatus
9. Gear Model
10. Kinematic Models to study various mechanisms

**ME2308          METROLOGY AND MEASUREMENT LABORATORY**

**LIST OF EXPERIMENTS**

Calibration of Vernier / Micrometer / Dial Gauge
Checking Dimensions of part using slip gauges
Measurements of Gear Tooth Dimensions
Measurement of Angle using sine bar / sine center / tool makers microscope
Measurement of straightness and flatness
Measurement of thread parameters
Setting up of comparators for inspection (Mechanical / Pneumatic / Electrical)
Measurement of Temperature using Thermocouple / Pyrometer
Measurement of Displacement
Measurement of Force
Measurement of Torque
Measurement of Vibration / Shock

TOTAL: 45 PERIODS

**LIST OF EQUIPMENT**

(For a batch of 30 students)

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<th>Equipment</th>
<th>Quantity</th>
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<td>Micrometer</td>
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<td>Vernier Caliper</td>
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<td>Vernier Height Gauge</td>
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<td>Vernier depth Gauge</td>
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<td>Slip Gauge Set</td>
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<td>Gear Tooth Vernier</td>
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<td>Sine Bar</td>
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<td>Sine Center</td>
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<td>Bevel Protractor</td>
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</table>
Floating Carriage Micrometer - 1
Profile Projector / Tool Makers Microscope - 1
Mechanical / Electrical / Pneumatic Comparator - 1
Autocollimator - 1
Temperature Measuring Setup - 1
Displacement Measuring Setup - 1
Force Measuring Setup - 1
Torque Measuring Setup - 1
Vibration / Shock Measuring Setup - 1

ME2309 CAD/CAM LABORATORY

OBJECTIVES:
- To understand and handle design problems in a systematic manner.
- To gain practical experience in handling 2D drafting and 3D modeling software systems.
- To apply CAD in real life applications.
- To understand the concepts G and M codes and manual part programming.
- To expose students to modern control systems (Fanuc, Siemens etc)
- To know the application of various CNC machines
- To expose students to modern CNC application machines EDM, EDM wire cut and Rapid Prototyping

3D GEOMETRIC MODELING

STL FILE GENERATION – REVERSE ENGINEERING
Manual CNC Part Programming

COMPUTER AIDED PART PROGRAMMING
CL Data Generation by Using CAM Software– Post Process Generation for Different Control System – Machining of Computer Generated Part Program by Using Machining Center and Turning Center.

STUDY OF EXPERIMENTS
Multi-axial Machining in CNC Machining Center – EDM – EDM Wire Cut - Rapid Prototyping
(Requirement for a batch of 30 students)

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<th>S.No.</th>
<th>Description of Equipment</th>
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<td>Computer Server</td>
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<td>Computer nodes or systems (High end CPU with atleast 1 GB main memory) networked to the server</td>
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<td>A3 size plotter</td>
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<td>Laser Printer</td>
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<td>5.</td>
<td>Trainer CNC Lathe</td>
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<td>Trainer CNC milling</td>
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<td><strong>SOFTWARE</strong></td>
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<tr>
<td>7.</td>
<td>CAD/CAM software</td>
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<tr>
<td>8.</td>
<td>CAM Software (CNC Programming and tool path simulation for FANUC /Sinumeric and Heiden controller)</td>
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<tr>
<td>9.</td>
<td>Licensed operating system</td>
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