Evaluation Scheme & Syllabus for
B. Tech. 3rd Year

Automobile Engineering

ON CBCS
[Effective from session 2018-19]
### V SEMESTER

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Teaching Dept.</th>
<th>L-T-P</th>
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**Department Elective Course –1**

RME055: Advanced Manufacturing Science  
RAU052: Vehicle Transport Management  
RME052: Mechatronics & Microcontroller  
RME053: Finite Element Analysis
DESIGN OF MACHINE ELEMENTS

UNIT I
Introduction
Design requirements of machine elements, Principles of mechanical design, Modes of failures and Factor of Safety. Systematic design process, Aesthetic and Ergonomic considerations in design, Use of standards in design, Manufacturing consideration in design, Selection of preferred sizes, Indian Standards designation, Designation of carbon & alloy steels, Selection of materials for static and fatigue loads.

UNIT II
Design for Static and Fluctuating Loads
Cyclic stresses, Fatigue and endurance limit, Notch sensitivity, Stress concentration. Design for finite and infinite life, Soderberg, Goodman & Gerber criteria.

Shafts, Keys and Couplings
Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads. Types of keys, splines, Selection of keys, Strength of keys, Design of rigid and flexible couplings.

UNIT III
Design of Mechanical Drives
Introduction to power transmission and drives. Classification of gears, Terminology, Gear tooth proportions, Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Failure of gear tooth, Design considerations, AGMA and Indian standards, Beam strength and wear strength of gear tooth, Design of spur and helical gears.

UNIT IV
Mechanical Springs
Classification of springs, Material for helical springs, End connections for compression and tension helical springs, Design of helical springs subjected to static and fatigue loading.

Power Screws
Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack.

UNIT V
Basic of Finite Element Method, Variational calculus, Integral formulation, variational methods: Methods of weighted residuals, Approximate solution using variational method, Modified Galerkin method, Boundary conditions.


Note: Design data book is allowed in the examination
Text Books:
2. Design of Machine Elements, Sharma and Purohit, PHI.
9. P Seshu, Finite Element Analysis, PHI publications, Delhi

References:
1. Design of Machine Elements-M.F. Spott, Pearson Eductaion
4. Design of Machine Elements, Gope PHI.
5. Finite Element Method with Applications in Engineering Y M Desai, Pearson Publication
6. Introduction to Finite Element Analysis by Tirupathi R.Chandrupatla & Ashok D Belegundu, Pearson Publication
UNIT-I
Introduction to Heat Transfer: Thermodynamics and Heat Transfer. Modes of Heat Transfer: Conduction, convection and radiation. Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism. 2 Conduction: General differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems. Initial and boundary conditions. 3 Steady State one-dimensional Heat conduction: Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Concept of thermal resistance. Analogy between heat and electricity flow; Thermal contact resistance and over all heat transfer coefficient; Critical radius of insulation.

UNIT-II
Fins: Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells. 3 Transient Conduction: Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts.

UNIT-III
Forced Convection: Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Thermal entrance region, Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer. Natural Convection: Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere, Combined free and forced convection.

UNIT-IV
Thermal Radiation: Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck’s law, Wein’s displacement law, Stefan Boltzmann law, Kirchoff’s law; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect.

UNIT-V
Heat Exchanger: Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers. 3 Condensation and Boiling: Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convection boiling. 3 Introduction to Mass Transfer: Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film.
Books:
1. Fundamentals of Heat and Mass Transfer, by Incroperra& DeWitt, John Wiley and Sons
3. Heat Transfer by J.P. Holman, McGraw-Hill
4. Heat and Mass Transfer by Rudramoorthy and Mayilsamy, Pearson Education
5. Heat Transfer by Ghoshdastidar, Oxford University Press
7. Heat Transfer by Venkateshan, Ane Books Pvt Ltd
AUTOMOTIVE ENGINES

Unit-I

Unit–II
SI Engines: Combustion in SI engine, Flame speed, Ignition delay, abnormal combustion and it's Control, combustion chamber design for SI engines, Carburetion, Mixture requirements, Caruretors and fuel injection system in SI Engine, Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark Plug, Electronic ignition, Scavenging in 2 Stroke engines, Supercharging and its effect

Unit–III
CI Engine: Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamber design of CI engines.
Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings, Exhaust emissions from SI engine and CI engine and it's control

Unit-IV
Engine Cooling and Lubrication: Different cooling systems, Radiators and cooling fans, Engine Friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation. Different Fuels used in SI & CI Engines.
Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines

Unit V
Compressors: Classification, Reciprocating compressors, Single and Multi stage compressors, Intercooling, Volumetric efficiency.
Rotary compressors, Classification, Centrifugal compressor, Axial compressors, Surging and stalling, Roots blower, Vaned compressor.

TEXT BOOKS:
4. Fundamentals of Internal Combustion Engines by W.W. Pulkrebek, Pearson Education
5. I.C Engine, by R. Yadav, Central Publishing House, Allahabad

REFERENCES:
5. AK Babu, Automotive Electrical and Electronics, Khanna Publishing house.
DESIGN AND SIMULATION LAB

1. Design & Modeling of Cotter joint.
2. Design & Modeling of Knuckle joint
3. Design & Modeling of riveted joint applied to boiler joints.
4. Study of a FEA package and modeling stress analysis of
   a. Bars of constant cross section area, tapered cross section area and stepped bar
   b. Trusses,
   c. Beams – Simply supported, cantilever, beams with UDL, beams with varying load etc
5. Mini Project: Will take up problems from real life applications and optimize using modeling and analysis software
   Each student will be given a real life problem for the complete design of a subsystem/system using either manual calculation with the help of design handbook or through computer programme or through software tools. This assignment should be done in groups, which will be submitted at the end of the semester.

Text Books:
2. Design of Machine Elements, Sharma and Purohit, PHI.
8. P Seshu, Finite Element Analysis, PHI publications, Delhi


References:
1. Design of Machine Elements-M.F. Spott, Pearson Eductaion
4. Design of Machine Elements, Gope PHI.
5. Finite Element Method with Applications in Engineering Y M Desai, Pearson Publication
6. Introduction to Finite Element Analysis by Tirupathi R.Chandrupatla & Ashok D Belegundu, Pearson Publication
Minimum eight experiment of the following

1. Conduction – Experiment on Composite plane wall
2. Conduction – Experiment on Composite cylinder wall
3 Conduction - Experiment on critical insulation thickness
4. Conduction – Experiment on Thermal Contact Resistance
5. Convection - Pool Boiling experiment
6. Convection - Experiment on heat transfer from tube-(natural convection).
10 Convection - Determination of thermal conductivity of fluid
11 Experiment on Stefan's Law, on radiation determination of emissivity, etc.
12 Experiment on solar collector, etc.
13. Heat exchanger - Parallel flow experiment
14. Heat exchanger - Counter flow experiment
1. Dismantling and study of Multi-cylinder Petrol Engine
2. Assembling of Multi-cylinder Petrol Engine
3. Dismantling and study of Multi-cylinder Diesel Engine
4. Assembling of Multi-cylinder Diesel Engine
5. Study of petrol engine fuel system
6. Study of diesel engine fuel system
7. Study and measurement of light and heavy commercial
8. Vehicle Frame
9. Study, dismantling and assembling of front and rear
10. Axles
11. Study, dismantling and assembling of differential
12. Study, dismantling and assembling of Clutch
13. Study, dismantling and assembling of Gear Box
14. Study of steering system
15. Performance of CI and SI engine
16. Impact of Variable compression ratio on Performance
ADVANCED MANUFACTURING SCIENCE

UNIT I
Introduction: Introduction to Advanced Manufacturing processes and its classification.

Mechanical Type Material Removal Processes: Ultrasonic machining; Elements of the process; Tool design and economic considerations; Applications and limitations, Abrasive jet and Abrasive water jet machining principles; Mechanics of metal removal; Design of nozzles; applications, Abrasive finishing process, Magnetic abrasive finishing process.

UNIT II
Thermal Type Material Machining Processes: Classification, General principles and applications of Electro discharge, Plasma arc, Ion beam, Laser beam, Electron beam machining, Mechanics of metal removal in EDM, selection of EDM pulse generator dielectric, machining accuracy, surface finish and surface damage in EDM, Generation and control of electron beam for machining applications, advantages and limitations

UNIT III
Chemical and Electro-chemical Type Material Removal Processes: Principle, working advantages, disadvantages and applications of Electrochemical, Chemical machining, Economy aspects of ECM, Electro-chemical deburring and honing.

UNIT IV
Hybrid Machining Processes: Introduction and working Principal of ECDM, ECAM, Abrasive EDM, Micro EDM etc.

UNIT V
Unconventional Forming processes: Principle, working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro Discharge forming, water hammer forming, explosive compaction etc.

Electronic-device Manufacturing: Brief description of Diffusion and Photo- Lithography process for electronic-device manufacturing

Books:
1. Advance Machining Processes V.K. Jain New Age
2. Modern Machining Processes P.C. Pandey New Age
3. Manufacturing Processes Degarmo -
VEHICLE TRANSPORT MANAGEMENT

UNIT-I

UNIT-II
Organisation and Management: Forms of ownership, principle of transport, management – internal organisation, centralised condition, decentralised condition (Engineering, traffic and administration), staff administration: industrial relation, administration, recruitment and training, welfare, health and safety.
Public relations divisions: Dissemination of information, maintaining goodwill- handling complaints, traffic advisory, committees- local contractors co-operation with the press news and articles- facilities for visitors- forms of publicity importance of quality - inter departmental liaison advertisements, signs, notice and directions general appearance of premises, specialized publicity.

UNIT-III
Prevention of accidents: Emphasis of safe driving- annual awards bonus encouragement vehicle design platform, layout, location of steps, scheduled route hazards records elimination of accident prone devices.
Route planning: Source of traffic, town planning, turning paints, stopping places, shelters survey of route preliminary schedule test runs elimination of hazards factors affecting. Frequency direction of traffic flow estimated traffic possibility single verses double deck.

UNIT-IV
Timing, bus working and schedules: Time table layout uses of flat graph method of presentation preparation of vehicle and crew schedule preparation of the duty roster, co-operation with employers use of the vehicle running numbering determination of vehicle efficiency, checking efficiency of crew, duty arrangements. Fare collections systems: Principles of collection the way bill, bell punch system reduced ticket stocks wilk brew system T.I.M and straight M/C/S. The verometer lensonparason coach tickets exchanges, box system personal and common stock flat fare platform control.

UNIT-V
The fare structure: Basis of fares historical background effects of competition and control calculating average zone system straight and tapered scale elastic and inelastic demand coordination of fares concessions fares changes for workman. Anomalies double booking inter availability through booking and summation private hire charges. Operating cost and types of vehicles: Classification costs, average speed running costs supplementary costs depreciation obsolescence, life of vehicles sinking fund factor affecting post per vehicles mile incidence of wages and overheads 100 seats miles basis, average seating capacity vehicles size and spread overs, types of vehicle economic considerations authorization of trolley, bus services, statuary procedure taxes and hire cars.

TEXTBOOKS:
1. Bus operation - L.d kitchen, iliffe & sons
2. Bus & coach operation - Rex w. fautks. butterworth version of 1987
3. Hybrid Electric Vehicles, AK Babu, Khanna Publishing House
UNIT-I
Introduction to finite difference method and finite elements method, Advantages and limitations, Mathematical formulation of FEM, Different approaches in Finite Element Method - Direct Stiffness approach, simple examples, Variational approach, Elements of variational calculus - Euler Lagrange equation, Rayleigh Ritz method, Weighted Residual methods, Point Collocation method, Galarkin method - Steps involved in FEM.

UNIT-II
Types of Elements Used Interpolation Polynomials - Linear elements Shape function - Analysis of simply supported beam - Element and Global matrices - Two-dimensional elements, triangular and rectangular elements - Local and Natural Co-ordinate systems.

UNIT-III
Finite Element Formulation of Field Problems 1-D and 2-D heat transfer, fluid flow (incompressible and non viscous fluid) in ducts, Simple electrical and magnetic field problems. Simple Numerical examples

UNIT-IV

UNIT-V

Books:
6. Introduction to Finite Elements in Engineering T.R Chandragupta and A.D. Belegundu Prentice Hall India
7. Finite Element and Approximation O.C. Zenkiewicy & Morgan –
UNIT - I
Introduction to Mechatronic Systems: Measurement and control systems their elements and functions, Microprocessor based controllers.


UNIT - II
Electrical Actuation Systems: Electrical systems, Mechanical switches, solid-state switches, solenoids, DC & AC motors, Stepper motors and their merits and demerits.


UNIT-III
Introduction to Microprocessors: Evolution of Microprocessor, Organization of Microprocessors (Preliminary concepts), basic concepts of programming of microprocessors.

Review of concepts - Boolean algebra, Logic Gates and Gate Networks, Binary & Decimal number systems, memory representation of positive and negative integers, maximum and minimum integers. Conversion of real, numbers, floating point notation, representation of floating point numbers, accuracy and range in floating point representation, overflow and underflow, addition of floating point numbers, character representation.

UNIT -IV
Logic Function: Data word representation. Basic elements of control systems 8085A processor architecture terminology such as CPU, memory and address, ALU, assembler data registers, Fetch cycle, write cycle, state, bus, interrupts. Micro Controllers. Difference between microprocessor and micro controllers. Requirements for control and their implementation in microcontrollers. Classification of micro controllers.

UNIT V
Organization & Programming of Microprocessors: Introduction to organization of INTEL 8085-Data and Address buses, Instruction set of 8085, programming the 8085, assembly language programming.

Central Processing Unit of Microprocessors: Introduction, timing and control unit basic concepts, Instruction and data flow, system timing, examples of INTEL 8085 and INTEL 4004 register organization.
REFERENCE BOOKS:
2. Microprocessor Architecture, Programming And Applications With 8085/8085A, R.S.
   Ganokar, Wiley Eastern.
4. Mechatronics - Principles, Concepts and applications – Nitaigour and Premchand Mahilik -
6. Introduction Mechatronics & Measurement systems, David G.
MAINTENANCE ENGINEERING & MANAGEMENT

Unit-I
Introduction, operating life cycle, reliability, Failure data analysis, failure rate curve, hazard models, elements in series, parallel, mix, logic diagrams, improving reliability, redundancy-element, unit, standby, maintainability, availability, reliability and maintainability trade off.

Unit-II
Maintenance Strategies: Break down maintenance, planned maintenance, strategies, preventive maintenance, design out maintenance, planned lubrication, total productive maintenance, zero break down, preventive inspection of equipment used in emergency.

Unit-III
Replacement planning maintain or replace decision, replacement of items that deteriorate identical equipment, replacement of items that fail without deterioration individual, group replacement, replacement in anticipation of failure.

Unit-IV
Break down maintenance planning, assignment model, waiting time models expected waiting time, minimum cost service rate, PERT.

Unit-V
Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materials planning, spare parts planning and control, evaluation of maintenance management.

Books:

# VI SEMESTER

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<th>Subject Code</th>
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<td>RME 654</td>
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### Department Elective Course –2

- RAU061 : Vehicle Dynamics
- RAU062 : Tribology
- RAU063 : Manufacturing of Automotive Components
- RME063 : Mechanical vibrations
AUTOMOTIVE FUELS AND LUBRICANTS

UNIT I
MANUFACTURE OF FUELS AND LUBRICANTS
Structure of petroleum refining process, classification of petroleum fuels, thermal cracking, catalytic cracking, polymerization, alkylation isomerisation, blending, products of refining process. Manufacture of lubricating oil base stocks, manufacture of finished automotive lubricants.

UNIT II
PROPERTIES & TESTING OF FUELS
Thermo-chemistry of fuels, properties and testing of fuels & Lubricants, relative density, calorific value, fire point, distillation, vapor pressure, flash point, spontaneous ignition, temperature, viscosity, pour point, flammability, ignitability, diesel index. API gravity, aniline point, Viscosity index etc.

UNIT III
FUEL RATING & ADDITIVES:
Fuels for SI and CI engine, important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Gaseous fuels
Additive - mechanism, requirements of an additive, petrol fuel additives and diesel fuel additives specifications of fuels, diesel knock, Cetane rating.

UNIT IV
ALTERNATE FUELS
Use of alternate fuel in engines- LPG. CNG need for alternate fuels, availability & their properties, general use of alcohols. LPG.CNG.LNG, hydrogen, ammonia, vegetable oils, biodiesel & biogas. merits & demerits of alternate fuels. Introduction to alternate energy sources like, electric vehicle, hybrid, fuel cell & solar cars.

UNIT V
LUBRICANTS
Classification of lubricating oils, properties of lubricating oils, tests on lubricants. Grease classification, properties, tests. Specific requirements for automotive lubricants, oxidation, deterioration and degradation of lubricants, additives, synthetic lubricants.
THEORY OF LUBRICANTS: Engine friction - introduction, total engine friction, effect of engine variables on friction, hydrodynamic lubrication, elasto hydrodynamic lubrication, boundary lubrication, bearing lubrication, functions of the lubrication system, introduction to design of a lubricating system.

TEXT BOOKS
REFERENCE BOOKS
THEORY OF MACHINES

Unit – I
INTRODUCTION: DEFINITIONS: Link or element, kinematic pairs, degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, structure, Mobility of Mechanism, Inversion, Machine Gashoff's criteria.
Kinematic Chains And Inversions: Inversions of Four bar chain; Single slider crank chain and Double slider crank chain.

MECHANISMS: Quick return motion mechanisms-Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism. Straight line motion mechanisms Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms Geneva mechanism and Ratchet and Pawl mechanism. Toggle mechanism, Pantograph, Davis & Ackerman steering gear mechanism.

Unit II
CAMS: Types of cams, Types of followers, Displacement, Velocity and Acceleration time curves for cam profiles. Disc cam with reciprocating follower having knife-edge, roller and flat-faced follower, Disc cam with oscillating roller follower, Follower motions including SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion.

Unit III
BALANCING OF MACHINERY: Static and Dynamic balancing, balancing of single rotating mass in same plane and in different planes. Balancing of several rotating masses in same plane and in different planes. Balancing of reciprocating masses. Inertia effect of crank and connecting road.

Unit - IV
SPUR GEARS: Gear terminology, law of gearing, Characteristics of involute action, Path of contact, Arc of contact, Contact ratio, Interference in involute gears, Methods of avoiding: interference, Backlash, Comparison of involute and cycloidal teeth

Unit V
BELTS, ROPES AND CHAINS: Introduction, Belt and Rope drives, open and crossed belt drives, action of belt on pulleys, velocity ratio, slip, law of belting, length of belt, Ratio of friction, chains, chain length and analytical, classification of chains.
GOVERNORS: Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronisms, effort and power.

Text Books:
Reference books:
Unit I

Automotive chassis: Definition; chassis layout; types of chassis layout with reference to power plant location, steering position and drive on wheels; chassis components; chassis classification; Automotive frames: Construction; functions; loads acting; materials; types; frame cross sections; frame diagnosis and service; dimensions of wheel base; wheel track; chassis overhang and ground clearance.

Unit II

Front axle & steering system: Functions, construction & types of front axle; front wheel geometry; front wheel drive; steering mechanisms; steering linkages & layout; types of steering gear boxes; power & power assisted steering; electronic steering; four-wheel steering; terminology-reversible steering, under-steering, over-steering, turning radius.

Unit III

Suspension system: Need; factors influencing ride comfort; types; suspension springs-leaf spring, coil spring & torsion bar; spring materials; independent suspension; rubber suspension; pneumatic suspension; hydraulic suspension, shock absorbers-liquid & gas filled.

Unit IV

Braking systems: Introduction, principles of braking; classification; brake actuating mechanisms; Drum brake- theory; principle; construction; working; Disc brake- theory, principle, construction, working; Parking brake- theory, principle; construction, types; Hydraulic system theory, principles, master-cylinder basics, wheel-cylinder basics, tubing & hoses, valves & switches, brake fluid; Powerbrake- theory, vacuum-booster basics, hydraulic-booster basics, electro-hydraulic booster basics; Advanced brake theories; Exhaust brake; abs technology; factors affecting brake performance operating temperature, area of brake lining, clearance.

Unit V

Wheel: Forces acting on wheels, construction of wheel assembly, types- spoke, disc & built-up wheels; wheel balancing; wheel alignment; Tyres: Static & rolling properties of tyres, construction details, types of tyres- pneumatic & hydraulic; types of tyre-wear & their causes; tyre rotation.

Bearings: Functions; classification of bearings; bearing materials; automotive bearings.

Books and References:

1. Automobile engineering", Dr. Kripal Singh.
2. A.K. Babu, Automotive Mechanics, Khanna Publishing House
3. Automobile engineering" K.M. Gupta.
Minimum eight experiments out of the followings:

1. Temperature dependence of viscosity of lubrication oil by Redwood Viscometer.
2. Viscosity Index of lubricating oil by Saybott Viscometer.
4. Flash and Fire points of lubricants.
5. Drop point of grease and mechanical penetration in grease.
7. Calorific value of gaseous fuel
8. Study of semi solid lubrication in various Automobile Unit & Joints
9. Study of lubrication in transmission, final drive, steering gearbox.
10. Study of analytical equipment for oil analysis.
11. To find out volatility characteristic of different fuels by ASTM distillation methods (diesel, gasoline lubricants).
Note: Minimum Ten experiments out of the following:
1. Study of simple linkage models/mechanisms
2. Study of inversions of four bar linkage
3. Study of inversions of single/double slider crank mechanisms
4. Experiment on Gears tooth profile, interference etc.
5. Experiment on Gear trains
6. Experiment on longitudinal vibration
7. Experiment on transverse vibration
8. Experiments on dead weight type governor
9. Experiment on spring controlled governor
10. Experiment on critical speed of shaft
11. Experiment on gyroscope
12. Experiment on static/dynamic balancing
13. Experiment on Brake
14. Experiment on clutch
DESIGN AND SIMULATION LAB-II

- Computer and Language: Students are required to refresh the basics of computer language such as C++ or MATLAB so that they should be able to write the computer program.
- Writing Computer programme for conventional design: Students are required to write computer program and validate it for the design of machine components done in theory subject.
- Mini Project: Based from real life applications and optimize using modelling and analysis software
- Students will take up a real life problem for design of a subsystem/system using modelling & Analysis software tools. This will be done as assignment in groups to be submitted at the end of the semester.

REFRIGERATION & AIR CONDITIONING Lab

<table>
<thead>
<tr>
<th>Minimum eight experiments out of the following:</th>
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<tbody>
<tr>
<td>1. Experiment on refrigeration test rig and calculation of various performance parameters.</td>
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<td>2. Study of different types of expansion devices used in refrigeration system.</td>
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<tr>
<td>3. Study of different types of evaporators used in refrigeration systems.</td>
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<tr>
<td>4. To study basic components of air-conditioning system.</td>
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<tr>
<td>5. Experiment on air-conditioning test rig &amp; calculation of various performance parameters.</td>
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<tr>
<td>6. Experiment on air washers</td>
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<tr>
<td>7. Study of window air conditioner.</td>
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<td>8. Study &amp; determination of volumetric efficiency of compressor.</td>
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<tr>
<td>10. Visit of cold-storage and its detailed study.</td>
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<tr>
<td>11. Experiment on Ice-plant.</td>
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<tr>
<td>12. Experiment on two stage Reciprocating compressor for determination of volumetric efficiency, PV diagram and effect of intercooling.</td>
</tr>
<tr>
<td>14. Experiment on Desert coolers.</td>
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</tbody>
</table>
1. Vehicle Dynamics
2. Tribology
3. Manufacturing of Automotive Components
4. Mechanical vibrations
5. Advanced welding Technology

VEHICLE DYNAMICS

UNIT I
CONCEPT OF VIBRATION

UNIT II
TIRES

UNIT III
VERTICAL DYNAMICS

UNIT IV
LONGITUDINAL DYNAMICS AND CONTROL

UNIT V
LATERAL DYNAMICS

TEXT BOOKS:

REFERENCES:
5. A.K. Babu, Hybrid Electric Vehicles, Khanna Publishing House
UNIT-I

Study of various parameters: Viscosity, flow of fluids, viscosity and its variation-absolute and
kinematic viscosity, temperature variation, viscosity Index determination of viscosity, different
viscometers used.
Hydrostatic lubrication: Hydrostatic step bearings, applications to pivoted pad thrust bearing and
other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearings.

UNIT II

Hydrodynamic theory of lubrication: Various theories of lubrication, petroff's equation, Reynold's
equation in two dimensions -Effects of side leakage - Reynold's equation in three dimensions, Friction
in sliding bearing, hydro dynamic theory applied to journal bearing, minimum oil film thickness, oil
whip and whirl anti –friction bearing.

UNIT-III

Friction and power losses in journal bearings: Calibration of friction loss friction in concentric
bearings, bearing modulus, Somraerfield number, heat balance, practical consideration of journal
bearing design considerations.

UNIT-IV

Air lubricated bearing: Advantages and disadvantages application to Hydrodynamic journal bearings,
hydodynamic thrust bearings. Hydrostatic thrust bearings. Hydrostatic bearing Analysis including
compressibility effect. Study of current concepts ofboundary friction and dry friction.

UNIT-V

Types of bearing oil pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing,
partial bearings -externally pressurized bearings.
Bearing materials: General requirements of bearing materials, types of bearing materials.

TEXT BOOKS:
1. Fundamentals of Tribotogy, Basu, SenGupta and Ahuja, PHI
2. Tribotogy in Industry: Sushil Kumar Srivatsava, S. Chand
&Co. REFERENCE:
1.Tribology - B.C. Majumdar
MANUFACTURING OF AUTOMOTIVE COMPONENTS

UNIT I
CASTED ENGINE COMPONENTS
Material selection and Manufacturing methods for Piston, Piston rings, Cylinder block, wet and dry liners, Engine head, Oil pan, Carburetors. Thermal barrier coating of Engine head and valves.

UNIT II
FORGED ENGINE COMPONENTS
Material selection and Manufacturing methods for Crank shaft, Connecting rod, Cam shaft, valve, Piston pin, Push rod, Rocker arm, tappets, spark plug.

UNIT III
TRANSMISSION SYSTEM

UNIT IV
VEHICLE CHASSIS

UNIT V
RECENT DEVELOPMENTS

TEXT BOOK:

REFERENCES:
2. A.K. Babu, Automotive Mechanics, Khanna Publishing House
3. Newton and steels, the motor vehicle, ELBS, 1990
MECHANICAL VIBRATION

UNIT – I

Introduction: Periodic motion, harmonic motion, superposition of simple harmonic motions, beats, Fourier analysis.

Single Degree Freedom System
Free vibration, Natural frequency, Equivalent systems, Energy method for determining natural frequency, response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement

UNIT – II
Single Degree Freedom: Forced Vibration
Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments

UNIT- III
Two Degree Freedom systems
Introduction, Principal modes, Double pendulum, Torsional system with damping, coupled system, undamped dynamic vibration absorbers, Centrifugal pendulum absorbers, Dry friction damper

UNIT- IV
Multi Degree Freedom system: Exact Analysis
Undamped free and forced vibrations of multi-degree freedom systems, influence number, Reciprocal theorem, Torsional vibration of multi-degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems- Longitudinal vibrations of bars, Torsional vibrations of circular shafts

UNIT- V
Multi Degree Freedom system: Numerical Analysis
Rayleigh’s, Dunkerely’s, Holzer’s ad Stodola methods, Rayleigh-Ritz method Critical speed of shafts
Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed.

Books and References:
1. Mechanical Vibrations – P. Srinivasan, TMH
2. Mechanical Vibrations – G. K. Groover, Jain Brothers, Roorkee
3. Mechanical Vibrations – JS Rao & K Gupta, New Age
4. Mechanical Vibrations-Theory & Practice, S Bhave, Pearson Education.
8. Mechanical Vibrations – Tse, Morse & Hinkle
10. Mechanical Vibrations – D. Nag, Wiley
ADVANCED WELDING TECHNOLOGY

Unit-I
Introduction : Importance and application of welding, classification of welding process. Selection of welding process.

Unit-II
Advanced welding Techniques- Principle and working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc.

Unit-III
Advanced welding Techniques (continued) : Principle and working and application of advanced welding techniques such as explosive welding/ cladding, Underwater welding, Spray-welding / Metallising, Hard facing.

Unit-IV

Unit-V

Books
1. Welding Hand Book