## Scheme and Evaluation Pattern

### UTTARAKHAND TECHNICAL UNIVERSITY
Program: B. Tech - AUTOMOBILE ENGG.

#### Year: 3  Session: 2011 – 2012

<table>
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<tr>
<th>S.No</th>
<th>Course No.</th>
<th>Subject</th>
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### Semester: 5th

#### Theory

1. TME - 502  Machine Design I  3 1 0  30 20 50  100 150
2. TME- 503  Dynamics of Machine  3 1 0  30 20 50  100 150
3. TME 504  Manufacturing Science II  3 1 0  30 20 50  100 150
4. EAU - 504  Automotive Transmission  3 1 0  30 20 50  100 150
5. TME- 505  Heat and Mass Transfer  3 1 0  30 20 50  100 150
6. TCS - 507  Concepts Of Programming and OOPS  2 1 0  15 10 25  50 75

#### Practical/Design

1. PME-551  Theory of Machine and Design Lab  0 0 2  0 0 25  25 50
2. PAU-552  Auto Mobile Engg. Lab I  0 0 2  0 0 0  25 25
3. PME-555  Heat and Mass Transfer Lab  0 0 2  0 0 25  25 50
4. PAU-556  Discipline  0 0 2  0 0 50  0 50

### Semester: 6th

#### Theory

1. TME - 601  Operation Research  3 1 0  30 20 50  100 150
2. TME - 602  Machine Design II  3 1 0  30 20 50  100 150
3. EAU - 603  Automotive Engines and Components  3 1 0  30 20 50  100 150
4. EAU - 604  Automotive Electrical And Electronic Systems  3 1 0  30 20 50  100 150
5. EAU - 605  Automotive Fuels and Combustion  3 1 0  30 20 50  100 150
6. THU - 608  Principles of Management  2 1 0  15 10 25  50 75

#### Practical/Design

1. PAU-651  Auto Mobile Engg. Lab II  0 0 2  0 0 25  25 50
2. PAU-652  Engine Testing Lab  0 0 2  0 0 25  25 50
3. PAU-655  Fuel Testing Lab  0 0 2  0 0 0  25 25
4. PAU-656  Discipline  0 0 2  0 0 50  0 50
TME-504 MANUFACTURING SCIENCE-II

Unit-I

A Metal Cutting and Machine Tools

Metal Cutting-

Unit-II

Machine Tools
(i) Lathe: Principle, types, operations, Turret/capstan, semi/Automatic, Tool layout. 2
(ii) Shaper, slotter, planer: operations & drives. 1
(iii) Milling: Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required. 2
(iv) Drilling and boring: Drilling, boring, reaming tools. Geometry of twist drills. 2

Unit-III

Grinding & Super finishing
(vi) Super finishing: Honing, lapping, polishing. 1

Limits, Fits & Tolerance and Surface-roughness:
Introduction to Limits, Fits, Tolerances and IS standards, and surface-roughness. 3

Unit-IV

B. Metal Joining (Welding)
Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing. 8

Thermodynamic and Metallurgical aspects in welding and welds. Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ. 3
Unit-V

C. Introduction to non conventional Manufacturing Process
Benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding application such as LBW, USW, EBW, Plasma arc welding, Explosive welding. HERE - Explosive Forming

Books
1. Manufacturing science by Ghosh and Mullick
2. Production Technology by R.K. Jain
3. Modern Machining Processes by P.C. Pandey & H.S. Shan
4. Manufacturing science by Degarmo
5. Manufacturing Technology Metal Cutting & Machine Tools by PN Rao, TMH
6. Manufacturing Technology Foundary, Forming & Welding by PN Rao, TMH
MACHINE DESIGN -I

UNIT-I
Introduction, Definition, Methods, standards in design & selection of preferred size. 3
Selection of materials for static & fatigue loads, Materials for components subjected to creep, BIS system of designation of steels, steels, plastics & rubbers. AISI (American Iron & Steel Institution), ASTM rubber testing methods.

UNIT-II
Design against static load.
Modes of failure, Factor of safety, stress-strain relationship, principal stresses, theories of failure 4
Design against fluctuating load stress concentration, stress concentration factors, Fluctuating/alternating stresses, fatigue failure, endurance limit, design for finite & infinite life, Soderberg & Goodman criteria.

UNIT-III
Joints
Welded joint, screwed joints, ecentric loading of above joints, design for fatigue loading.
Shaft, keys & coupling.
Design against static and fatigue loads, strength & rigidity design, Selection of square & flat keys & splines, rigid & flexible couplings.

UNIT-IV
Mechanical springs
Design of Helical and leaf springs, against static & fatigue loading.

Design analysis of Power Screws
Form of threads, square threads, trapezoidal threads, stresses in screw, design of screw jack.

UNIT-V
Introduction to Product Development & Design Process

Books
1. Design of M/c Elements : Bhandari, TMH
3. M/C Design : Maleev & Hartman,
DYNAMICS OF MACHINES

UNIT-I
Force Analysis, Turning Moment & Fly wheel:

UNIT-II
Balancing of machines:
Static and dynamic balancing, Balancing of rotating and reciprocating masses, Primary and secondary forces and couples.

UNIT-III
Friction:
Pivot and collar friction, Friction circle, Single plate, Multiplate and Cone clutches, Michelle & Kingsbury thrust bearing and rolling contact bearing, Belts and pulleys, Flat and V-belts, Design and selection.

Brakes and Dynamometers (Mechanical Type):
External and internal shoe brakes, Band and Block brakes, Hydraulic brakes, Absorption and Transmission dynamometers.

UNIT-IV
Governors:
Dead weight and spring loaded governors, Sensitivity, Stability, Hunting, Isochronism, Effort and Power, Friction and Insensitivity, Introduction to inertia governors.

UNIT - V
Gyroscopic Motion:
Principles, Gyroscopic acceleration, Gyroscopic couple and Reaction. Effect of gyroscopic couple upon the stability of aeroplanes, ship, two & four wheelers.

Books and References
UNIT 1:

**Transmission requirements:** requirements of transmission system, general arrangement of power transmission, general arrangement of rear-engine vehicle with live axles, general arrangement of dead-axle and axles transmission; four-wheel-drive transmission.

Unit 2:

**Clutches:** Requirements of clutches, principle of friction clutches, types of clutches and materials used- cone, single-plate, diaphragm-spring, multi-plate, centrifugal, over-running and ferroelectromagnetic clutch.

Unit 3: **Gear box:** Need of gear boxes, types- sliding mesh, constant mesh and epicyclic, gear boxes; synchronizers: principle, and design of gear box; Hydrodynamic drive: Advantages and limitations, principle of fluid coupling, constructional details, torque-capacity performance characteristics, drag torque, methods of minimizing drag torque; Torque converter: performance characteristics; single, , converter-coupling-performance characteristics,

Unit 4:

**Transmission systems-Drive line:** Definition, forces & torques acting; types of drives-Hotchkiss, torque tube & radius rod drives; components- propeller shaft, slip joint, universal joints & constant velocity universal joints; front wheel drive; Final drive: definition; types- worm-wheel, straight-bevel gear, spiral-bevel gear & hypoid-gear drives; double-reduction & twin-speed final drives

**Differential:**

Function, principle, construction and working; non-slip differential; differential lock; rear axle- loads acting & types; multi-axled vehicles.

Unit 5:

**Automatic transmission:** Hydraulic control system of automatic transmission; Electric drive: advantages and limitations, principle of , modern electric drive for buses; performance characteristics.

References:
1 Heldt P.M.; Torqueconverters; Chilton Book Co.

2 Giri NK; Automobile Engineering; Khanna Publisher

3 Newton, Steeds & Garret; Motor Vehicles; B.H. Publication.

4 Judge, A.W., Modern Transmission Systems, Chapman & Hall Ltd.

5 Check Chart; Automatic Transmission; Harper & Row Publication.
HEAT & MASS TRANSFER

UNIT-1
Introduction to Heat Transfer:
Concepts of the mechanisms of heat flows: conduction, convection and radiation; effect of temperature on thermal conductivity of materials; introduction to combined heat transfer mechanism. 2

Conduction:
One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; initial and boundary conditions. 3

Steady State one-dimensional Heat conduction:
Composite Systems in rectangular, cylindrical and spherical coordinates with and without Energy generation; thermal resistance concept; Analogy between heat and electricity flow; thermal contact resistance; critical thickness of insulation. 3

UNIT-2
Fins of uniform cross-sectional area; errors of measurement of temperature in thermometer wells. 2

Transient Conduction:
Transient heat conduction Lumped capacitance method, Time constant unsteady state heat conduction in one dimension only, Heisler charts. 4

UNIT-3
Forced Convection:
Basic concepts; hydrodynamic boundary layer; thermal boundary layer, flow over a flat plate; flow across a single cylinder and a sphere; flow inside ducts; empirical heat transfer relations; relation between fluid friction and heat transfer; liquid metal heat transfer. 4

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. 5

UNIT-4
Thermal Radiation:
Basic radiation concepts; radiation properties of surfaces; black body radiation laws; shape factor; black-body radiation exchange; Radiation exchange between diffuse nonblackbodies in an enclosure; radiation shields; solar radiation. 7

UNIT-5
Heat Exchanger:
Types of heat exchangers; fouling factors; overall heat transfer coefficient; logarithmic mean
temperature difference (LMTD) method; effectiveness-NTU method; compact heat exchangers.

**Condensation And Boiling:**
Introduction to condensation phenomena; heat transfer relations for laminar film condensation on vertical surfaces and on a horizontal tube; Boiling modes pool boiling, curve, forced convective boiling.

**Introduction To Mass Transfer:**
Introduction; Flick's law of diffusion; steady state equimolar counter diffusion; steady state diffusion though a stagnant gas film.

**Books**
UNIT 1
UTILIZATION: Developer fundamentals such as editor, integrated programming environment, UNIX shell, modules, libraries.
PROGRAMMING FEATURES: Machine representation, primitive types, arrays and records, objects, expressions, control statements, iteration, procedures, functions, and basic I/O.
APPLICATIONS: Sample problems in engineering, science, text processing, and numerical methods.

UNIT 2

UNIT 3

UNIT 4
RDBMS- DATA PROCESSING: the database technology - data models, ER modeling concept - notations - Extended ER features, Logical database design - normalization, SQL - DDL statements - DML statements - DCL statements, Writing Simple queries - SQL Tuning techniques - Embedded SQL - OLTP

TEXTBOOK:

OTHER REFERENCES (Not required reading):
Thinking in C++ 2nd Edition by Bruce Eckel (available online)
Polya, G., How to Solve _It (2nd ed.), Doubleday and co. (1957).
THEORY OF MACHINE & DESIGN LAB
(Say min 3 out of these)
1. Design & drawing of a cotter joint.
2. Design & drawing of a knuckle joints.
3. Design & drawing of a simple screw jack.
4. Design of shaft for different loading conditions.
5. Design & drawing of rigid coupling (flanged type).
6. Design & drawing of a leaf spring for an automobile.
7. Design & drawing of a helical spring for a given application.

Note -
1. Students may be advised to use design data book for design.
2. Drawing shall be made wherever necessary on small drawing sheets.

Min. 5 out of following (or such) experiments to be done:
1. Study of simple linkers/models/mechanisms.
2. Exp. on Velocity acceleration.
3. Exp. on cam.
4. Exp. on Governor.
5. Exp. on critical speed of shaft (whirling of shaft)
6. Exp. on Gyroscope
7. Exp. on Balancing (static & dynamic)
8. Exp. on 4-bar mechanism
9. Exp. on Gears (tooth profile, interference etc.)
10. Exp. on Gear trains.
11. Exp. on Mechanism
15. Exp. on Vibration (spring)
AUTOMOBILE ENGG. LAB. -I
1. Study of hand tools- sketching, materials used and their applications.
2. Writing technical specifications and description of all types of automobile engines.
3. Study of traffic rules as per M.V. Act 1988 and driving practice of four wheel vehicle.
4. Trouble shooting charts for all engine components.
5. Note the specifications of given engines and component standard dimensions. Dismantle & assemble of engine components of SI and CI engines (Two stroke and four stroke engines) of any commercial vehicles,
using special tools needed. Note procedure of dismantling & assembly; identify the major components, noting their functions & materials used. Measurement & comparison of major components dimension with standard specifications. Inspection for wear and tear, crack, breakdown. Identify the service requirements of engine, such as decarburizing, degreasing, sparkplug cleaning, fuel injector cleaning, etc.
6. Compression test, vacuum test on diesel and petrol engines.
7. Study (Dismantling & assembly): Different carburetors, fuel injection pumps, injectors, fuel tanks, fuel filters, fuel pumps, turbo-chargers, cooling systems and lubricating systems. Identify location of above components in a vehicle and note their functions along with the brand names.
PME-555
HEAT & MASS TRANSFER - LAB
(min 8 experiment of the following or such experiment)

1. Conduction - Composite wall experiment
2. Conduction - Composite cylinder experiment
3. Convection - Pool Boiling experiment
4. Convection - Experiment on heat transfer from tube-natural convection.
8. Any experiment - Such as on Stefen's Law, on radiation determination of emissivity, etc.
9. Any experiment - Such as on solar collector, etc. on radiation
10. Heat exchanger - Parallel flow experiment
11. Heat exchanger - Counter flow experiment
12. Any other suitable exp such as on critical insulation thickness.
13. Conduction - Determination of thermal conductivity of fluids.
TAE-601 : OPERATIONS RESEARCH

Unit-I
Linear Programming-
Introduction & Scope, Problem formulation, Simplex methods, primal & dual problem 8

Unit-II
Transportation & Assignment problems. 4

Unit-III
Decision theory-
Decision under various conditions. 4

Game Theory-
Minimax & maximum strategies. Application of linear programming. 4

Unit-IV
Stochastic inventory models-
Single & multi period models with continuous & discrete demands, 8

Unit-V
Simulations-
Simulation V/S mathematical modeling, Monte carlo simulation, simulation languages, 4

Queing models-
Introduction Model types, M.M. 1 & M/M/S system cost consideration 4

Reference Books
Operations Research by : Wangner
Production Planning of Operation Management : by Buffa.
Operations Research by : Taha
UNIT I
Spur Gears 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, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards.

Helical Gears Terminology, Proportions for helical gears, Beam strength and wear strength of helical gears, herringbone gears, crossed helical gears, Design of helical gears.

Worm Gears Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of worm gearing.

UNIT II

Rolling Contact Bearing Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Selection of rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing.

UNIT III
IC ENGINE PARTS
Selection of type of IC engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin; Design of connecting rod; Design of centre crankshaft.

References:
3. Machine design-M.F. Spott, Prentice Hall India
UNIT-I
Review of IC engines,
Principles of engine operation (SI & CI), Port timing diagrams.

UNIT II
Engine components
- Classification/types, function, materials, construction details, manufacturing, Troubles & Remedies and Design of major dimensions of the following engine components
  Cylinder heads & Cylinder Block
Cylinder heads, Gaskets, cylinder wear, water jacket, Cylinder liners, and valve seats. Production of engine block – casting, cleaning, treatment, machining operations and transfer machines
  Crank Case, Manifolds and Mufflers
Crank Case – General form of crank case, oil sumps and cooling features, flywheel mountings, Engine mountings, Front & Rear mountings. Manifolds and Mufflers - inlet and exhaust manifolds, mixture distribution, heating by exhaust gas, dual manifolds, General Design of Manifolds, effect of firing order,
Mufflers, general design.
  Piston, piston rings, piston pin

UNIT III
Connecting rod
Length of rod, Cross section, Buckling, Drilled connecting rods, piston pin bearing, offset connecting rods, effects of whipping, bearing materials, lubrication.
  Crankshaft
Balance weights, local balance, Crankshaft proportions, oil holes drilled in crank shafts, balancing, vibration dampers, firing order, bearings, lubrication.
Valve and valve mechanism

No. of Valves per cylinder, Angle of seat, Operating Conditions, operating temperatures, valve cooling, Sodium cooled valves, Valve rotators, valve seats, valve guides, valve springs, valve clearance, valve timing, OHV, OHC, dual valves, types of valve operating mechanisms. Valve train component details, Camshaft, drives of cams, cam types, tappets, automatic zero clearance tappets, push rods, rocker arms & rocker Shaft.

REFERENCE BOOKS:
1. A course in I.C. Engine - Mathur & Sharma, Dhanpat Rai & Sons, Delhi, 1994
2. Internal Combustion Engines-V Ganesan, Tata McGraw Hill, Delhi, 2002
3. Automobile Engineering Vol. II - Kirpal Singh, Standard publications, New Delhi, 2005
UNIT-1 Storage
Battery:
Principle of lead acid cells, plates and their characteristics, containers and separators, electrolyte and their preparation, voltmeter, effect of temperature on electrolyte, its specific gravity, capacity and efficiency, methods of charging from D.C. mains, defects and remedies of batteries, care of idle and new batteries. Recent development in batteries

Generator/ Alternator:
Principle of generation of direct current, generator details, shunt, dynamos, armature reaction, action of three brush generator and battery in parallel, setting of third brush, voltage and current regulators, cutout - construction, working and adjustment. Construction of A.C. systems.

Starter Motor & Drives:
Battery motor starting system, condition at starting, behaviour of starter during starting, series motor and its characteristics, consideration affecting size of motor, types of drives, starting circuit.

UNIT-II
Ignition systems:
Ignition fundamentals, Types of solid state ignition systems, components, construction And operating parameters high energy ignition distributors, Electronic spark timing And control.

UNIT-III
Wiring and Lighting system:
Earth return and insulated systems, 6volts and 12 volts system, fusing of circuits, low and high voltage automobile cables, diagram of typical wiring system. Principle of automobile illumination, head lamp mounting and construction, sealed beam auxiliary lightings, horn, windscreen-wipers, signaling devices, electrical fuel pump, fuel, oil and temperature gauge(Dash board instruments)

UNIT-IV
Engine management Systems:
UNIT-V

Chassis Electrical systems:

Antilock brakes (ABS), Active suspension, Traction control, Electronic control of automatic transmission, other chassis electrical systems, Central locking, Air bags and seat belt tensioners.

REFERENCE BOOKS:
UNIT-1

**Energy Sources:**

UNIT-2

**Liquid Fuels:**
Origin of petroleum, its chemistry, normal paraffin’s, isoparaffins, olefins, naphthalene and aromatics. Refining of petroleum: Fractional distillation, Cracking, Reforming process, Thermal reforming, polymerization, alkylation, and isomerisation. Properties and tests: Specific Gravity, viscosity, flash and fire points, calorific value, rating of fuels, vapour pressure, cloud and pour point, annealing point, diesel index, carbon residue and ash content determination

UNIT-3

**Combustion of Fuels:**

UNIT-4

**Petrol and Diesel Fuels:**
Properties and rating of fuels, chemical energy of fuels, Reaction Equation, Properties of A/F mixture, combustion temp, combustion charts, Lead free gasoline’s, low and ultra – low sulphur diesels, LPG, CNG, Alcohols, Biodiesels, Gaseous Fuel Injections, Dual Fueling and Controls – CNG and Gasoline, Hydrogen and Diesel, Alcohols and Diesels etc.ENGINE PERFORMANCE: Performance parameters BHP, FHP, IHP, specific fuel consumption, volumetric efficiency, Thermal efficiency, heat Balance sheet, Testing of Engines, Numerical problems

UNIT-5

**Cycle Analysis:**
Otto, Diesel, Dual, sterling and Brayton cycles, comparison of air standard, fuel air and actual cycles, simple problems on the above topics. Rotary engines. Stirling engine, Stratified charge engine

**Combustion in S.I Engines**
Initiation of combustion, flame velocities, effect of variables on flame propagation, normal and abnormal combustion, knocking combustion, pre-ignition, knock and engine variables, detonation, effects of engine variables on combustion, control of detonation, CFR engine, features and design consideration of
Combustion in C.I. Engines
Various stages of combustion, vaporization of fuel droplets and spray formation, air motion, swirl, squish, tumble flow, velocities, swirl measurement, and delay period correlations, diesel knock and engine variables, features and design considerations of combustion chambers, types, heat release correlations.

REFERENCE BOOKS:
UNIT 1
INTRODUCTION TO MANAGEMENT: Theories of management: Traditional behavioral, contingency and systems approach. Organization as a system.

UNIT 2
MANAGEMENT INFORMATION: Interaction with external environment. Managerial decision making and MIS.

UNIT 3
PLANNING APPROACH TO ORGANIZATIONAL ANALYSIS: design of organization structure; job design and enrichment; job evaluation and merit rating.

UNIT 4

References:
PAU-651  
AUTOMOBILE ENGG. LAB -II  
0 0 2  

1. Writing technical specifications and description of all types of chassis and transmission components of automobiles, including body and interiors (two wheeler, four wheeler and heavy vehicle – one each)  
2. Trouble shooting charts for major parts like clutch, gear box, differential, brakes, and wheels with tyres, steering system and suspension.  
3. Testing and servicing of electrical components like battery, starting system, ignition system, central locking system, lighting system, and alternator. Experiments on microprocessors related to automobiles  
4. Dismantle and assemble of major systems (clutch system, Gear boxes, Propeller shaft, Differential, Front and Rear axles, brake system, steering system and suspension system) and identifying remedies (like backlash adjustment, brakes adjustment, bleeding of brakes) for the possible problems based on trouble shooting charts.  
5. Draw sketch of seating arrangements, seats for commercial vehicle and study the comfort levels provided for driver and passengers.  
6. Draw sketches of different mechanisms of door, seat adjustments mechanisms  

PAU-652  
ENGINE TESTING LAB  
0 0 2  

1. Testing of Single Cylinder, TwinCylinder and multi cylinder SI / CI engines for performance, calculate BP, Thermal, volumetric efficiencies, and BSFC with emission testing.  
2. Study one engine performance by changing parameters like valve timing, ignition timing, carburetor nozzle jet.  
3. Conduct Morse test for finding FP, IP, Indicated thermal efficiency and Mechanical efficiency.  
4. Study of engine performance using alternate fuels like alcohol blends/ bio diesel / LPG.  
5. Performance test on computerized IC engine test rig.  
6. Study and testing on MPFI Engine and Variable compression Engine.  
7. Tuning of engines. Study and practice on computerized engine analyzer.  
8. Exhaust Emission test of Petrol and Diesel engines
PAU-655
FUEL TESTING AND FLUID MECHANICS LAB

1. Determination of Flash and Fire Points of fuels and lubricants
2. Determination of calorific values of solid, liquid and gaseous fuels
3. Determination of viscosity of oils using Redwood, Say bolts and Torsion viscometer.
4. Measurement of areas of irregular figure Using of Plan meters
5. Determination of Carbon residue and Moisture content in a fuel.
6. Determination of cloud and pour points of light, medium and heavy oils.
7. Drawing of Valve and port timing diagram for a given engine.
8. Determination of compression ratio for a given engine.
11. Determination of coefficient of discharge of venturi meter, orifice meter.
12. Determination of major and minor losses in pipe flow (bend, sudden expansion, sudden contraction, entry and exit).