

**Punjab Technical
University**

B.Tech. Automobile Engineering (AE)
Batch 2011

3rd Semester

Contact Hours :33

Code	Title of Course	Load Allocation			Maximum Marks		Total Marks	Credits
		L	T	P	Internal	External		
BTAE 301	Mechanics of Materials	3	1		40	60	100	4
BTAE 302	Applied Thermodynamics	4	1		40	60	100	5
BTAE 303	Automotive Chassis Systems	3			40	60	100	3
BTAE 304	Manufacturing Processes	4			40	60	100	4
BTAE 305	Automotive Materials	3			40	60	100	3
BTAE 306	Machine Drawing	1		6	40	60	100	4
BTAE 307	Mechanics of Materials Lab.			2	30	20	50	1
BTAE 308	Automotive Chassis Systems Lab.			2	30	20	50	1
BTAE 309	Manufacturing Processes Lab.			2	30	20	50	1
Advisory Meeting				1				
BTAE 310	Workshop Training*				60	40	100	2
Total		18	2	13	390	460	850	28

***Workshop Training will be imparted in the institution at the end of 2nd semester for Four (04) weeks duration (Minimum 36 hours per week). Industrial Tour will also form part of this training.**

Punjab Technical University

B.Tech. Automobile Engineering (AE)

Batch 2011

4th Semester**Contact Hours :31**

Code	Title of Course	Load Allocation			Maximum Marks		Total Marks	Credits
		L	T	P	Internal	External		
BTAE 401	Internal Combustion Engines	5			40	60	100	5
BTAE 402	Mechanics of Machines	4	1		40	60	100	5
BTAE 403	Fluid Mechanics and Machinery	4	1		40	60	100	5
BTAE 404	Automotive Electrical Systems	4			40	60	100	4
BTAE 405	Automotive Fuels & Emissions	5			40	60	100	4
BTAE 406	Internal Combustion Engines Lab.			2	30	20	50	1
BTAE 407	Fluid Mechanics and Machinery Lab			2	30	20	50	1
BTAE 408	Automotive Electrical Systems Lab.			2	30	20	50	1
Advisory Meeting				1				
General Fitness					100		100	
Total		22	2	7	390	360	750	26

Note: There shall be an industrial training of six (06) weeks duration (minimum 36 hours per week) at the end of 4th semester. The marks for this will be included in the 5th semester.

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5th Semester**Contact Hours :31**

Code	Title of Course	Load Allocation			Maximum Marks		Total Marks	Credits
		L	T	P	Internal	External		
BTAE 501	Vehicle Body Engineering	4			40	60	100	4
BTAE 502	Automotive Transmissions	5			40	60	100	4
BTAE 503	Heat Transfer	4	2		40	60	100	5
BTAE 504	Design of Automotive Components	4	1		40	60	100	5
BTAE 505	Measurements and Instrumentation	4			40	60	100	4
BTAE 506	Measurements and Instrumentation Lab.			2	30	20	50	1
BTAE 507	Automotive Transmissions Lab			2	30	20	50	1
BTAE 508	Vehicle Body Engineering Lab			2	30	20	50	2
Advisory Meeting				1				
BTAE 509	Industrial Training*				60	40	100	2
Total		21	3	7	350	400	750	28

* The marks of the Industrial Training imparted at the end of 4th semester will be included here.

**Punjab
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**B.Tech. Automobile Engineering (AE)
Batch 2011**

6th Semester

Contact Hours :33

Code	Title of Course	Load Allocation			Maximum Marks		Total Marks	Credits
		L	T	P	Internal	External		
BTAE 601	Computer Aided Automotive Design	4	1		40	60	100	5
BTAE 602	Refrigeration and Air-conditioning	4	1		40	60	100	5
BTAE 603	Vehicle Dynamics	4	1		40	60	100	5
BTAE 604	Special Purpose Vehicles	4			40	60	100	4
BTAE 605	Safety Engineering	4			40	60	100	4
BTAE 606	Elective-1	3			40	60	100	3
BTAE 607	Computer Aided Automotive Design Lab			2	30	20	50	1
BTAE 608	Refrigeration and Air-conditioning Lab			2	30	20	50	1
BTAE 609	Minor Project*			2	30	20	50	1
Advisory Meeting				1				
	General Fitness				60	40	100	
Total		23	3	7	390	460	850	29

* The project work will be carried out in parts as minor project in the 6th semester and major project in 7/8th semester. The literature survey, problem formulation, assessment for viability of the project, objectives and methodology for the project shall be decided in 6th semester. The same project problem is to be extended in the major project in 7th/8th semester. The minor project may be carried out by a group of students.

List of Elective-I

BTAE/DE 610	Servo Mechanism and Automatic Controls
BTAE/DE 611	Automotive Aerodynamics
BTAE/DE 612	Design of Energy Systems
BTAE/DE 613	Tractor and Farm Equipment
BTAE/DE 614	Finite Element Analysis

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Batch 2011

7th /8th Semester Industrial Training (one Semester)					
Code	Title of Course	Maximum Marks		Total Marks	Credits
		Internal	External		
	Software Training	150	100	250	8
	Industrial Oriented Project Training	300	200	500	10
		450	300	750	18

Total Contact Hours per week = 36 (minimum)

Industrial Training in reputed industries will be arranged for complete one semester.

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Batch 2011

7th / 8th Semester

Contact Hours :30

Code	Title of Course	Load Allocation			Maximum Marks		Total Marks	Credits
		L	T	P	Internal	External		
BTAE 701	Transport Management and Automotive Industry	4			40	60	100	4
BTAE 702	Vehicle Maintenance & Diagnostics	4			40	60	100	4
BTAE 703	Automotive Electronics Systems	4			40	60	100	4
BTAE 704	Elective – II	4			40	60	100	4
BTAE 705	Open Elective	3			40	60	100	3
BTAE 706	Automotive Electronics Systems Lab			2	30	20	50	1
BTAE 707	Vehicle Maintenance & Diagnostics Lab			2	30	20	50	1
BTAE 708	Major Project*			6	100	50	150	3
Advisory Meeting				1				
	General Fitness				60	40	100	
Total		19		11	420	430	850	24

* The problem formulated in the minor project during 6th semester is to be extended and executed in the major project by the same group of students. The design/construction/fabrication/computer modeling/experimentation etc. is to be carried out. The results and analysis followed by discussion regarding suitability / non suitability of the project or any positive gain in the project made with conclusions and recommendations for future extension of the project must be covered.

Elective-II

BTAE/DE 709	Automation and Mechantronics
BTAE/DE 710	Reliability Engineering
BTAE/DE 711	Off- Road vehicles
BTAE/DE 712	Hybrid Vehicles

Open Elective

BTAE/OE 713	Human Resource Management
BTAE/OE 714	Operation Research
BTAE/OE 715	Industrial Engineering
BTAE/OE 716	Total Quality Management
BTAE/OE 717	Material Management

B.Tech. Automobile Engineering 3rd Semester

(Syllabus Batch 2011)

BTAE 301

Mechanics of Materials

L	T	P
3	1	-

Internal Marks: 40

External Marks: 60

Simple, Compound Stresses and Strains: Stress and Strain and their types, Hook's law, longitudinal and lateral strain, Poisson's ratio, stress-strain diagram for ductile and brittle materials, Stress in a bar, Analysis of bars of varying sections, composite section, elastic constants and their significance, Temperature stress and strain calculation due to axial load and variation of temperature in single and compound bars. Two dimensional stress system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stress.

Bending Moment (B.M) and Shear Force (S.F) Diagrams: S.F and B.M definitions; relation between load, shear force and bending moment; B.M and S.F diagrams for cantilevers, simply supported beams with or without overhangs, and calculation of maximum B.M and S.F and the point of contra flexure under the following loads:

- a) Concentrated loads
- b) Uniformity distributed loads over the whole span or part of span
- c) Combination of concentrated and uniformly distributed load

Bending Stresses In Beams: Pure Bending or simple bending, Neutral axis and moment of resistance, Assumptions in the simple bending theory; derivation of formula and its application to beams of rectangular and circular section. Section modulus, section modulus for circular and rectangular section beam, combined direct and bending stresses, bending stress of composite / flitched beams.

Shear stresses in beams: Shear stress at a section, Shear stress distribution in rectangular and circular sections.

Torsion: Derivation of torsion equation, assumptions and its application to the hollow and solid circular shafts, Torsional rigidity, Power transmitted by the shaft, Modulus of rupture, comparison of solid and hollow shafts, principal stress and maximum shear stresses under combined loading of bending and torsion of circular shaft.

Columns and struts: Introduction, failure of columns, Euler's formula and assumptions, different end conditions, Limitations of Euler's formula. Rankine-Gordon's formula.

Theories of failure: Strain energy in tension, compression, shear, bending and torsion Maximum principal stress theory, maximum shear stress theory, maximum principal strain theory, total strain energy theory, shear strain energy theory. Graphical representation and derivation of equation for these theories and their application to problems related to two dimensional stress systems.

Thin cylinders: Calculation of Hoop stress, longitudinal stress in a thin cylinder, effect of internal pressure on the change in diameter, length and internal volume.

Text Books

- Bansal R.K., "A text Book of Strength of Materials", Laxmi Publications.
- Singh Kirpal, "Mechanics of Materials", Standard Publishers and Distributors.
- Bedi D.S., "Strength of Materials", Khanna Book Publishing Company.
- Popov E.P., "Mechanics of Materials", Prentice Hall India.
- Rattan S.S., "Strength of Materials", Tata McGraw Hill.

BTAE 302			Applied Thermodynamics	
L	T	P	Internal Marks:	40
4	1	-	External Marks:	60

Air Compressors

Introduction; Classification; Application of compressors and use of compressed air in industry and other places; Complete representation of compression process on P-v and T-s coordinates

with detailed description of areas representing total work done and polytropic work done; Areas representing energy lost in internal friction, energy carried away by cooling water and extra flow work on T-s coordinates for un-cooled and cooled compression; Definitions of isentropic, polytropic and isothermal efficiencies and their representation in terms of ratio of areas representing various energy transfers on T-s coordinates.

Reciprocating Air Compressors

Single stage single acting reciprocating compressor (with and without clearance volume): construction, operation, work input and best value of index of compression, heat rejected to cooling medium, isothermal, overall thermal, isentropic, polytropic, mechanical, and clearance volumetric efficiency, overall volumetric efficiency, effect of various parameters on volumetric efficiency, free air delivery; Multistage compressors: purpose and advantages, construction and operation, work input, heat rejected in intercoolers, minimum work input, optimum pressure ratio, isothermal, overall thermal, isentropic, polytropic and mechanical efficiency.

Positive Displacement Rotary Compressors

Introduction; Classification; Comparison of rotary compressors with reciprocating compressors; Construction, operation, work input and efficiency of rotary compressors like roots blower, Lysholm compressor and Vane type Blower.

Centrifugal Compressors

Construction and operation; Applications of Steady Flow Energy Equation and thermodynamics of dynamic compressors; Stagnation and static values of pressure, Temperature and enthalpy for flow through dynamic machines; Complete thermodynamic analysis of centrifugal compressor stage; Polytropic, isentropic and isothermal efficiencies; Complete representation of compression process starting from ambient air flow through suction pipe, Impeller, Diffuser and finally to delivery pipe on T-S coordinates; Pre-guide vanes and pre-whirl; Slip factor; Power input factor; Various modes of energy transfer in impeller and diffuser; Energy transfer in backward, forward and radial vanes; Pressure coefficient as a function of slip factor; Efficiency and out-coming velocity profile from the impeller; Derivation of non-dimensional parameters for plotting compressor characteristics; Centrifugal compressor characteristic curves; Surging and choking in

centrifugal compressors.

Axial Flow Compressors

Different components of axial flow compressor and their arrangement; Working; Discussion on flow passages and simple theory of aerofoil blading; Angle of attack; coefficients of lift and drag; Turbine versus compressor blades; Velocity vector; Vector diagrams; Thermodynamic analysis and power calculations; Modes of energy transfer in rotor and stator blade flow passages; Detailed discussion on work done factor, degree of reaction, blade efficiency and their derivations; Isentropic, polytropic and isothermal efficiencies; Surging, Choking and Stalling in axial flow compressors; Comparison of axial flow compressor with centrifugal compressor; Field of application of axial flow compressors.

Gas Turbines

Classification on the basis of system of operation (open and closed cycles) and on the basis of combustion (at constant volume or constant pressure); Comparison of open and closed cycles; Comparison of gas turbine with IC engine; Fields of application of gas turbines; Position of gas turbine in power industry; Thermodynamics of constant pressure gas turbine cycle (Brayton cycle); Calculation of net output, work ratio and thermal efficiency of ideal and actual cycles; Cycle air rate, temperature ratio; Effect of changes in specific heat and that of mass of fuel on power and efficiency; Multistage compression and expansion; Dual Turbine system; Series and parallel arrangements; Closed and semi-closed gas turbine cycle; Requirements of a gas turbine combustion chamber; Gas turbine fuels.

Jet Propulsion

Principle of jet propulsion; Description of different types of jet propulsion system like rockets and thermal jet engines like (i) Athodyds (ramjet and pulsejet), (ii) Turbojet engine, (iii) Turboprop engine. Thermodynamics of turbojet engine components; Types of rocket motors (e.g. solid propellant and liquid propellant systems); Various common propellant combinations (i.e. fuels) used in rocket motors; Cooling of rockets; Advantages and disadvantages of jet propulsion over propulsion systems.

Books

- Yadav R.and Rajay, “Applied Thermodynamics”, Central Publishing House.
- Nag P.K., “Basic and Applied Thermodynamics”, Tata McGraw Hill.
- Kumar D.S. and Vasandani V.P., “Heat Engineering”, Metropolitan Book Co. Pvt. Ltd.
- Shepherd D.G., “Principles of Turbo machinery”, Macmillan.
- Rogers G.F.C. and Sarvan M., “Gas Turbine Theory”, Longmans.
- Yahya S.M., “Elementary Gas Dynamics”, Satya Prakashan.

BTAE303 Automotive Chassis Systems

L	T	P	Internal Marks:	40
3	-	-	External Marks:	60

Introduction

Types of chassis layout with reference to power plant locations and drive, Vehicle frames. Load acting on vehicle frame due to different systems.

Front Axle & Steering System

Types of front axles, Constructional details, materials. Front wheel geometry viz. Castor, Camber, King pin inclination, Toe. Wheel Alignment. Steering geometry. Ackerman and Davis steering system. Different types of steering gear boxes. Steering linkages and their layouts. Power and power assisted steering. Steering of crawler tractors. Multi axle steering systems.

Driveline and Differential

Effects of driving thrust and torque reactions. Hotch kiss drive, torque tube drive and radius rods. Transverse rods. Propeller shaft, Universal joints. Constant velocity universal joints. Drive Shaft. Front wheel drive. Different types of final drives. Spiral bevel gear and hypoid gear final drives. Double reduction and twin speed final drives. Differential principles. Constructional details of a differential gear unit. Non-slip and Limited slip differential. Differential locks - Differential housings. Comparison of front wheel, rear wheel and all wheel drive arrangement.

Drive axles

Construction of rear axles. Types of loads acting on rear axles. Fully floating, three quarter floating, and semi floating rear axles. Rear axle housing. Construction of different types of axle housing, multi axled vehicles. Construction details of multi drive axle vehicles. Dead axles.

Suspension system

Need of suspension system, Types of suspension, Suspension springs, Constructional details and characteristics of leaf, coil and torsion bar springs, Independent suspension, Types: Mc Pherson strut, Double wishbone, Five link type, etc, Rubber suspension, Pneumatic suspension, Shock absorbers.

Wheels and Tires

Types of wheels – wire spoke, disc – solid and split type, alloy type, offset, onset & zero set, denomination of rim. Tires, materials, construction, structure, denomination and function of tires, types of tires, comparison of radial and bias ply tires. Tubes – construction and types, Tubeless tires. Tire inflation, effects of tire pressure on tire performance. Tire wears patterns and their causes. Rolling Resistance and self aligning torque, Wheel Balancing – need, procedure. All season tires, tire quality grading, changing tire sizes. Run flat tires (RFT), new heat resistant tires for better mileage, fuel efficient handling and safety.

Braking System

Weight transfer during braking and stopping distances. Classification of brakes - drum brakes and disc brakes. Constructional details. Theory of braking, Brake split and proportioning. Mechanical, hydraulic and pneumatic brakes - Servo brake, power and power-assisted brakes - Different types of brake retarders like eddy current and hydraulic retarder. Skidding of wheels on braking and remedies, Anti lock braking systems:-types, system components, operations, fluids. Power Brakes and Parking Brakes, Additive, self energizing brakes, regenerative and emergency braking system.

Text Books:

- Reimpell and Betzler, "The Automotive Chassis: Engineering Principles", Second Edition Butterworth Heinemann London.
- Giancarlo Genta, "The Automotive Chassis volume I and volume II", Springer.

- Heinz Heisler, "Advanced Vehicle Technology", Second Edition Butterworth Heinemann London.
- Gilles T., "Automotive Chassis Brakes Steering and Suspension", Thomson USA.
- Newton Steeds and Garrot, "Motor vehicles ", Butterworths, London.
- Judge A.W., "Mechanism of the car ", Chapman and Halls Ltd., London.

BTAE 304 Manufacturing Processes

L	T	P	Internal Marks:	40
4	-	-	External Marks:	60

Casting Processes

Introduction to metal casting, types of patterns, their materials and allowances. Moulding materials: Moulding sand compositions and moulding sand properties, types of moulds, moulding machines cores, core sands, types of cores, core banking, elements of gating system, and risers. Casting processes: sand casting, shell mould casting, investment casting, permanent mould casting, full mould casting, and vacuum casting. Die casting, Centrifugal casting and continuous casting. Casting defects, their causes and remedies.

Welding

Welding introduction and classification of welding processes, welding terminology, welding positions, filler metals. Flame cutting. Electric arc welding. Principle, equipment, types- MIG, TIG, submerged arc welding. Welding electrodes, classification and selection of electrodes, welding arc and its characteristics. Thermal effects on weldment Resistance welding- principle and their types i.e. spot, seam, projection, upset and flash thermit welding, electro slag welding, friction welding, plasma arc welding, electron beam welding. Welding defects, their causes and remedies.

Metal Forming: Classification, Process Principles, Description, Applications and Products of the following;

Rolling , Drawing, Forging, Extrusion, Sheet Metal, Spinning, Deep Drawing, Bending, Press working, Plastic moulding machines and extruders.

Metal Cutting and Machine Tools: Cutting tool materials and geometry, Coolants: Classification, purpose and their effects, Introduction to broaching machine, Milling machine and its classification, indexing: Simple compound and differential, Boring Operation and their machines, Jig Boring, Slotting Machine, Grinding: Cylindrical, surface and centreless grinding.

Introduction to Non Traditional Machining; Working Principle and applications of the following:

Electric Discharge Machining, Laser Beam Machining, Abrasive Water Jet Machining, Abrasive Flow Machining, Electro Chemical Machining, Chemical Machining.

Books

- Heine R.W. and Rosenthal P.C., "Principles of Metal Casting", Mc Graw Hill.
- Parmar R.S., "Welding Technology", Khanna Publishers.
- Campbell J.S., "Principles of Manufacturing Materials and Processes", Tata McGraw Hill.
- Alton T., "Metal forming fundamentals and applications", Addison-Wesley.
- Sharma P.C., "Production Technology", S. Chand Publisher.

BTAE 305			Automotive Materials	
L	T	P	Internal Marks:	40
3	-	-	External Marks:	60

Introduction: Engineering materials, material classifications, mechanical, thermal, electrical, magnetic ,chemical, optical and physical properties of materials, effects of alloying elements on properties of steel, carbon steel, low alloy steels, stainless steel, tool steels and die steels.

Alloys of Ni, Al, Cu, Mg; properties and their applications. Recrystallization temperature, their effect on the properties of materials.

Ceramic Materials: Introduction, nature of ceramic materials, types, products, properties developments in ceramics.

Glass: Introduction, composition, structure, types of glass and their properties, use of glass, fracture in glass.

Rubber: Introduction, characteristics of rubbers, structure of elastomers, types of elastomers, vulcanization of rubber, uses of rubber and applications.

Plastics Materials: Introduction, definition and concept, properties of plastics, thermoplastics, thermosetting plastics, deformation of plastics, plastic alloys.

Fundamentals of composites - need for composites – Enhancement of properties -classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Fibre reinforced composites, Applications of various types of composites.

Polymer Matrix Composites

Polymer matrix resins – Thermosetting resins, thermoplastic resins – Reinforcement fibres – various types of fibres. Fibre reinforced plastics (FRP), Glass fibre reinforced plastics (GRP).

Ceramic Matrix Composites

Engineering ceramic materials – properties – advantages – limitations – Monolithic ceramics - Need for CMC – Ceramic matrix - Various types of Ceramic Matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing).

Advances in Composites

Carbon / carbon composites – Advantages of carbon matrix – limitations of carbon matrix Carbon fibre –

Heat treatment and surface treatment: Heat treatment of steel – Annealing, Normalizing, Hardening and tempering with their types and application to automotive components,

Surface Hardening Techniques: Induction, flame and chemical hardening, coating of wear and corrosion resistance, Electroplating, Phosphating, Anodizing, hot dipping, thermal spraying, hard facing and thin film coatings.

Selection of materials: Factors affecting the selection of materials, Cryogenic wear, corrosion, fatigue, creep and oxidation resistance application. Criteria of selecting materials for automotive components viz cylinder block, Cylinder head, piston, piston ring, Gudgeon pin, connecting rod, crank shaft, crank case, cam, cam shaft, engine valve, gear wheel, clutch plate, axle, bearings, chassis, spring, body panel - radiator, brake lining etc. Materials for heavy duty vehicles: special alloys, plastics, seat fabrics and materials for bumpers.

Books:

- Khanna.O.P., "Material Science and Metallurgy ", Dhanpat Rai and Sons.
- Agarwal B.K., "Introduction to Engineering Materials", Tata McGraw-Hill.
- Dogra Rakesh, "Advances in Material Science", Katson Books.
- Mathews F.L. and Rawlings R.D., "Composite Materials", Chapman and Hall, London, England, 1st edition, 1994.
- Chawla K.K., "Composite materials", Springer – Verlag, 1987.
- Strong A.B., "Fundamentals of Composite Manufacturing", SME, 1989.
- Sharma S.C., "Composite materials", Narosa Publications, 2000.

BTAE 306 MACHINE DRAWING

L	T	P		Internal Marks:	40
1	-	6		External Marks:	60

Principles of drawing: Requirements of production drawing, sectioning and conventional representation, dimensioning, symbols of standard tolerances, machining symbols, Introduction and familiarization of the code IS: 296.

Fasteners: Various types of screw threads, types of nuts and bolts, screwed fasteners, welding joints and riveted joints

Assembly and Disassembly of the following manually and using computer aided drafting.

- a) Couplings: Solid or rigid Coupling, Protected type flange coupling, Pin type flexible coupling, muff coupling, Oldham, universal coupling, claw coupling, cone friction clutch, free hand sketch of single plate friction clutch.
- b) Knuckle and cotter joints
- c) Pipe and Pipe fittings: flanged joints, spigot an socket joint, union joint, hydraulic an expansion joint
- d) IC Engine Parts: Piston, connecting rod
- e) Boiler Mountings: steam stop valve, feed check valve, safety valve, blow off cock.
- f) Bearings: swivel bearing, thrust bearing, Plummer and angular plumber block
- g) Miscellaneous: Screw Jack, Drill Press Vice, Crane hook.

Drafting of simple mechanical components on computer.

NOTE:

Drawing Practice is to be done as per IS: 296 code. First angle projection to be used. Drawings should contain bill of materials and should illustrate finish.

The syllabus given above indicates the broad outlines and the scope of the subject to be covered. It is not necessary to cover all the drawing exercises of the types of machine tools mentioned above.

Books

- Singh Ajit, "Machine Drawing", Tata McGraw Hill.
- Bhatt N.D., "Machine Drawing", Charotar publications.
- Sidheshwar N., "Machine Drawing", Tata McGraw Hill.
- Gill P.S., "Machine Drawing", B.D. Kataria and Sons.
- Narayanan V. Lakshmi and Mathur, "Text-book of Machine Drawing", Jain Brothers.
- Dhawan R.K., "Machine Drawing", S. Chand.

BTAE 307 Mechanics of Materials LAB

L	T	P		Internal Marks:	30
-	-	2		External Marks:	20

List of Experiments

1. To perform tensile test in ductile and brittle materials and to draw stress-strain curve and to determine various mechanical properties.
2. To perform compression test on C.I. and to determine ultimate compressive strength.
3. To perform shear test on different materials and determine ultimate shear strength.
4. To perform any one hardness test (Rockwell, Brinell & Vicker's test) and determine hardness of materials.
5. To perform impact test to determine impact strength.
6. To perform torsion test and to determine various mechanical properties.
7. Study of performance of Fatigue & Creep tests
8. To perform bending test on beam (wooden or any other material) and to determine the Young's modulus and Modulus of rupture
9. To perform Torsion test on helical springs in tension and compression and to determine modulus of rigidity/stiffness

BTAE 308 Automotive Chassis Systems LAB

L	T	P		Internal Marks:	30
-	-	2		External Marks:	20

List of Experiments

1. Study of layout of a chassis and its different components, of a vehicle.
2. Trouble shooting in different types of steering systems - mechanical and power and various steering linkages.
3. Measurement of steering geometry angles – Wheel Alignment.
4. Study of impact of steering geometry angles on vehicle

5. Study of different types of wheels (rims) and tires and their defects
6. Conducting Wheel balancing of a given wheel assy.
7. Trouble shooting in Propeller Shafts and Drive shafts including constant velocity joints.
8. Trouble shooting in different types of dead axles (front or rear)
9. Trouble shooting in different types of live axles and Differential systems.
10. Trouble shooting in suspensions of following types:
 - a) Leaf Spring
 - b) Double Wishbone with Torsion Bar or Coil Spring
 - c) McPherson Strut Type
 - d) Five Bar Link type
 - e) Air Suspension system
 - f) A shock absorber (damper)

Trouble shooting in braking system in master and wheel cylinder, drum and disc brakes, overhauling and adjusting of system and its testing on brake tester

		BTAE 309	Manufacturing Processes Lab		
L	T	P		Internal Marks:	30
-	-	2		External Marks:	20

List of Experiments

Welding Practical's

1. Study of Arc welding equipment and making a weld joint by this process.
2. Study of MIG welding equipment and making a weld joint by this process.
3. Study of Spot welding and preparing a weld joint by this process.

Machining Practical's

1. Study of constructional features of following machines through drawings/ sketches and an exercise based on them:-
 - a) Universal milling machine
 - b) Grinding machines (Surface, cylindrical)
 - c) Hydraulic Press

Industrial Visit to demonstration of Machines

B.TECH. AUTOMOBILE ENGINEERING 4TH SEMESTER

BTAE 401 Internal Combustion Engines

L	T	P	Internal Marks:	40
5	-	-	External Marks:	60

Fundamentals

Engine terminology, classification. Working principle of two stroke and four stroke engine, scavenging, scavenging processes. Thermodynamic cycles for automobile engine- Air standard cycle, Otto cycle, Diesel cycle, Dual cycle, Comparison between different cycles, Valve timing diagram for engine under different conditions, Firing order, Factors affecting on selection of firing order, Square Engine, Wankel engine, Engine Mountings.

Constructional Details

Cylinder block, Engine cylinder, Cylinder liner, Cylinder Head and cover, Piston for C.I. and S.I. engine, Piston rings, Piston pin, Connecting rod, Crank shaft, Main bearings, Cam shaft, Oil pan, Engine mountings and Engine balancing, Vibration Damper, Cam shafts & drives, Inlet and exhaust valves, Valve actuating mechanism including variable control system, Air cleaner, Manifold & gasket – intake and exhaust, silencer, tail pipe.

Combustion in S.I. Engine

Ignition limits, Stages of combustion in petrol engine, Ignition lag, Effect of engine variables on ignition lag, Effect of engine variables on flame propagation, Abnormal combustion, Detonation, Effects of detonation, Theories of detonation, Effects of engine variables on knock, Control of knock. Surface ignition, Pre ignition, Post ignition, S.I. engine combustion chamber design, Types of combustion chambers for S.I. engine, Very high output combustion chamber engines

Combustion in C.I. Engine

Air fuel ratio in C.I. engine, Stages of combustion in C.I. engine, Delay period, Variables affecting on delay period, Diesel knock, Methods of controlling diesel knock, C.I. engine combustion chamber, Direct injection type, Open type, Turbulent type, Pre chamber, M combustion

chamber, Cold starting of C.I. engine- decompression devices, heater plug, inlet manifold heater, Chemical spray

Petrol Engine Fuel Supply System

Methods of fuel supply system- gravity system, pressure system, Vacuum system, pump system, Components of fuel supply system –Fuel tank, fuel pump (Mechanical and Electrical) Vapor return line, Air cleaner, Fuel filters, Carburetion, Functions of carburetor, simple carburetor, Limitations of simple carburetor, Types of Carburetor-Solex and SU carburetor, Special features of modern carburetor. Benefits of electronic fuel injection system.

Diesel Engine Fuel Supply System

Comparison of diesel engine with petrol engine, Requirements of diesel injection system, Fuel feed pump, Types of injection system, fuel injection pump, and fuel injectors. Fuel filter, air cleaner, Phasing and calibration of fuel injection pump, Injector Testing (pressure test, leak test) Electronic control of fuel injection system

Engine Friction, Lubrication and Lubricants

Total engine friction, Effects of engine variables on engine friction, Lubrication- Objectives of lubrication, Lubricants used, Requirements & selection of lubricants, Viscosity rating, Multi grade oil, Additives used in lubricant, Effects of engine variables on lubricating oil, Oil consumption, Different parts of engine to be lubricated,

Types of lubrication system- petrol system, Wet sump method, Dry sump method, fully and partially pressurized lubrication system, Components of lubrication system- oil strainer, Oil filter and its types.

Engine Cooling System:

Distribution of heat supplied to engine, Necessity of engine cooling, Piston and engine Cylinder temperatures, Factors affecting on piston temperature, Types of cooling system, Air cooling system, Water cooling system, Thermosyphon cooling, Cooling with thermostatic regulator. Components of water cooling system-Radiator, Pressure Cap, Expansion Reservoir, Coolants, Thermostat, Water Pump, Viscous coupling, Comparison between water cooling and air cooling. Effects of over and under cooling.

Supercharging

Objects of supercharging, Relative power with and without supercharging, Supercharging of spark ignition engine, Supercharging of C.I. engine, Effects of supercharging on performance of engine, Supercharging limits for S.I. and C.I. engine, Methods of super charging, Supercharges, Turbo charging, Comparison with supercharging, Methods of turbo charging, Limitations of turbo charging.

Performance Testing of Engine

Losses in the engine, Performance parameters, Performance curves, Methods of improving performance of engine, Testing of engine, Classification of testing, Basic measurement- Speed, Fuel consumption, Air consumption, Mean effective pressure, Brake power, Indicated power, Frictional power (with different methods), Mechanical efficiency, Thermal efficiency, volumetric efficiency, Heat balance sheet, Engine analyzer.

Text Book:

- Ganesan.V., "Internal Combustion Engines ", Tata-McGraw Hill.
- Ramalingam K.K., "Internal Combustion Engines Theory and Practice", Scitech Publications (India).
- Gupta H.N., "Fundamentals of Internal Combustion Engines", PHI Learning.
- [Willard W. Pulkrabek](#), "Engineering fundamentals of the Internal combustion engine", Pearson Prentice Hall.
- Maleev.V.M., "Diesel Engine Operation and Maintenance ", McGraw Hill.
- William H. Crouse, "Automotive Engines ", McGraw Hill.

BTAE 402

Mechanics of Machines

L T P
4 1 -

Internal Marks: 40
External Marks: 60

Basic Concept of machines: Link mechanism kinematic pair and chain, principles of inversion, inversion of a four bar chain, slider-crank-chain, double slider-crank chain and their inversions, kinematic pairs.

Determination of forces and couples for a crank, inertia of reciprocating parts, dynamically equivalent system, analytical and graphical method, inertia force analysis of basic engine mechanism torque required to overcome inertia and gravitational force of a four bar linkage.

Belts, Ropes and Chains: Material, types of drives, idle pulley, intermediate or counter shaft pulley, angle and right angle drive, quarter turn drive, velocity ratio, crowning shaft pulley, loose and fast pulley, stepped or cone pulleys, ratio of tension on tight and slack sided of belts, HP transmitted by belts including consideration of creep and slip, centrifugal tensions and its effect on HP transmitted. Use of gravity, idle, flat, V-belts and rope materials. Length of belt, rope and chain drives, type and cone type.

Cams: Types of cams and follower, definitions of terms connected with cams, displacement velocity and acceleration diagrams for cam followers. Analytical and Graphical design of cam profiles with various motions (SHM, uniform acceleration and retardation) .

Flywheels: Turning moment and crank effort diagrams for reciprocating machines Fluctuations of speed, coefficient of fluctuation of speed and energy, Determination of flywheel mass and dimensions for engines and Punching Machines

Governors: Function, types and characteristics of governors, Watt, Porter and Proell governor. Hartnell and Willson Hartnell, spring loaded governors, Simple numerical problems on these governors. Sensitivity, stability, isochronisms and hunting of governors, Governor Effort and power controlling force curve, effect of sleeve friction.

Balancing: Classifications, need for balancing, balancing of single and multiple rotating masses, static and dynamic balancing, primary and secondary balancing for reciprocating masses, partial balancing of locomotives, swaying couple, hammer blow, variation in tractive effort, balancing of V-engine, concept of direct and reverse crank, balancing of machines, rotors, reversible rotors.

Books

- Lal Jagdish, "Theory of Mechanisms and Machines", Metropolitan Book Co. Pvt. Ltd. New Delhi.
- Rattan S. S., "Theory of Machines", Tata McGraw Hill, New Delhi.
- Beven Thomas, "Theory of Machines", Longman's Green & Co., London.

- Green W. G., "Theory of Machines", Blackie and Sons, London.
- Shigley I.E. and Uicker J.R., "Theory of Machines", Mcgraw Hill , New York.

BTAE 403 Fluid Mechanics and Machinery

L	T	P	Internal Marks:	40
4	1	-	External Marks:	60

Fluid and their properties: Concept of fluid, difference between solids, liquids and gases; ideal and real fluids; capillarity, vapors pressure, compressibility and bulk modulus; Newtonian and non- Newtonian fluids.

Fluid Statics: Concept of pressure, Pascal's law and its engineering applications, Hydrostatic paradox. Action of fluid pressure on a plane (horizontal, vertical and inclined) submerged surface, resultant force and center of pressure, force on a curved surface due to hydrostatic pressure. Buoyancy and flotation, stability of floating and submerged bodies, metacentric height and its determination.

Fluid Kinematics: Classification of fluid flows, velocity and acceleration of fluid particle, local and convective acceleration, normal and tangential acceleration, streamline, path line and streak line, flow rate and discharge mean velocity, continuity equation in Cartesian and cylindrical, polar coordinates. Rotational flows, rotation velocity and circulation, stream and velocity potential functions, flow net.

Fluid Dynamics : Euler's equation, Bernoulli's equation and steady flow energy equation; representation of energy changes in fluid system, impulse momentum equation, kinetic energy and momentum correction factors, flow along a curved streamline,

Dimensional Analysis and Similitude: Fundamental and derived units and dimensions, dimensional homogeneity. Rayleigh's and Buckingham's Pi method for dimensional analysis.

Dimensionless numbers and their significance, geometric, kinematic and dynamic similarity, model studies.

Introduction to Laminar and Turbulent Flows. Flow in circular cross- section pipes. Turbulent flows and flow losses in pipes, Darcy equation, minor head losses in pipes and pipe fittings, hydraulic and energy gradient lines.

Flow Measurement: Manometers, pitot tubes, venturi meter and orifice meters, orifice, mouthpieces, notches and weirs, rotameter.

Fluid machinery

Basic components of a turbo machine and its classification on the basis of purpose, fluid dynamic action, operating principle, geometrical features, path followed by the fluid. Classification, Principle of operation of centrifugal and axial pumps, Construction, operation and utility of simple accumulator, intensifier, gear, vane and piston pumps.

Books

- Kumar D.S., "Fluid Mechanics and Fluid Power Engineering", Kataria and Sons Publishers.
- Massey B.S., "Mechanics of Fluids", Van Nostrand Reinhold Co.
- Douglas J.F., "Fluid Mechanics", Poitman.
- Streetes V.L. and Wylie E.B., "Fluid Mechanics", Mcgraw Hill Book Co.
- Lal Jagdish, "Hydraulic Machines", Metropolitan Book Co Pvt. Lt.

BTAE 404 Automotive Electrical Systems

L	T	P		Internal Marks:	40
4	-	-		External Marks:	60

Introduction

Earth returns and insulated return systems, 6, 12, and 24-volt systems. Positive & negative earth systems, Fusing of circuits, relays, switches, low and high voltage automotive cables, wiring diagram for typical automotive wiring systems, maintenance and servicing.

Batteries

Principles of lead acid cells and their characteristics - construction and working of lead acid battery, types of batteries, testing of batteries, effect of temperature on: capacity and voltage, battery capacity, voltage, efficiency, charging of batteries, sulphation and desulphation, maintenance and servicing, Battery failures & checking, Maintenance free Batteries, High energy and power density batteries for electric vehicles.

Charging system

Principle of generation of direct current. Shunt generator characteristics. Armature reaction. Third brush regulation. Cut-out. Voltage & current regulators, compensated voltage regulator. Alternators - principle, constructional and working aspects, bridge rectifiers. Principle of Magneto, Flywheel Magneto, Maintenance and servicing. Trouble shooting in charging systems.

Starting system

Condition at Starting – starting torque and power requirements, behavior of starter during starting. Series motor and its characteristics. Principle & construction of starter motor. Working of different starter drive units, care & maintenance of starter motor. Starter switches. Safety mechanism. Maintenance, servicing and trouble shooting.

Ignition system

Types, construction & working of battery & coil and magneto ignition systems. Relative merits, Ballast Resistor, Ignition coil, Distributor, Contact breaker Point, centrifugal and vacuum advance mechanisms, Limitations of conventional ignition systems, Transistorized Ignition systems, Spark plugs - construction, different types, plug fouling, maintenance, servicing and fault diagnosis, Electronic Ignition system. Programmed ignition, distributor less ignition.

Lighting system

Principle of automobile illumination, headlamp construction and wiring, reflectors – types, signaling devices flashers, stop lights, fog lamps, auxiliary lighting-engine, passenger, reading lamp. Regn-plate lamps. Automatic illumination system. Head light levelling devices. Study of a modern headlight system with improved night vision.

Electrical Equipment and Accessories

Oil pressure gauge, fuel level gauge, engine temperature gauge, electrical fuel pump, speedometer, odometer, trip meter, engine rpm meter, Headlamp & Windshield washer and wiper, heaters and defrosters, horns, stereo/radio, power antennae. Central locking, power window winding. Sun/Moon Roof. Motorized rear view mirrors, reverse warning, Bumper collision warning. Other accessories in modern vehicles.

Fuel Cells

Thermodynamic aspects; types-hydrogen and methanol, power rating and performance. Various components and working of fuel cell, Heat dissipation.

Drive Motors and controllers:

Drive arrangements in Hybrid and Electric vehicles. Drive motors: types and construction. Controlling of motor operations. Motor-generator in hybrid vehicles and its controls.

Books

- Kohli P.L., "Automotive Electrical Equipment ", Tata McGraw-Hill.
 - Chapman, "Principles of Electricity and Electronics for the Automotive Technician", Thomson Asia, 2000.
 - Judge A.W., "Modern Electrical Equipment of Automobiles", Chapman & Hall, London.
 - Vinal G.W., "Storage Batteries ", John Wiley & Sons Inc.
 - W.H. Crouse, "Automobile Electrical Equipment ", McGraw Hill Book Co. Inc.
 - F.G. Spreadbury, "Electrical Ignition Equipment", Constable & Co Ltd.
 - C.P.Nakra, "Basic Automotive Electrical Systems", Dhanpat Rai and sons
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BTAE 405 Automotive Fuels & Emissions

L T P
5 - -

Internal Marks: 40

External Marks: 60

SECTION A

Introduction to Fuels

Classification of automotive fuels and drivetrains, Scenario of conventional auto fuels, Oil reserves of the world fuel quality aspects related to emissions, technological up gradations required, Need for alternate fuel, business driving factors for alternative fuels, roadmap for alternative fuels, alternate fuel development worldwide.

Automotive Fuels: Properties, production, storage, handling, performance and safety aspects, advantages and disadvantages, Emissions, Engine modifications of the following

- Gaseous Automotive Fuels: Hydrogen, Compressed natural gas, Liquefied petroleum gas:
- Bio –Fuels
- Biogas, Biodiesel:
- Alcohols
- Methanol, Ethanol, DEE, DME:
- Synthetic alternate Fuels
- Wood Gas, Tyre Pyrolysis Oil:
- Reformulated Conventional Fuels
- Emulsified Fuels:

Future alternative fuels

Ammonia: properties, ammonia in nature, hazards, carrier for hydrogen, storage, stationary engine application, ammonia for fuel cell vehicles.

Boron: properties, overview of the boron – water process, features, analysis.

Water: Japanese water car, water fuel cell, hydrogen boosters, water to gas technology.

SECTION B

Introduction to emission

Pollutants, sources, formation of HC and CO in SI engines, NO formation in SI and CI engines, Particulate emission from SI and CI engines, Smoke Emission in CI engines. Effect of operating variables on Emission formation, Transient operational effects on pollution

SI Engine & CI Engines Combustion and Pollutant Formation

Basic Chemistry combustion - HC and CO formation in 4-stroke and 2-stroke SI engines - NO formation, - Particulate emissions, - Effects of operating variables on emission formation. Smoke emissions, Color and aldehyde emissions. Photochemical smog, Sulphur, Phosphorus emissions,

Post Combustion Treatment

Introduction, physical conditions and exhaust gas compositions before treatment, catalytic mechanism. Thermal reactions, installation of catalyst in exhaust lines, NO_x treatment in diesel engines. Diesel trap oxidizers

Control Techniques Engine Emission Reduction

Design changes - Optimization of operating factors - Exhaust gas recirculation - Fumigation - Air injection PCV system - Exhaust treatment in SI engines - Thermal reactors - Catalytic converters - Catalysts - Use of unleaded petrol.

Test Procedure & Instrumentation for Emission Measurement

Test procedures, NDIR analyzer, thermal conductivity and flame ionization detectors, Chemiluminescent analyzer, analyzers for NO_x, Gas chromatograph - Orsat apparatus -Smoke meters, spot sampling and continuous indication types like Bosch, Hart ridge.

Text Books:

- Thipse S.S., "Alternative Fuels", Jaico Publications.
- Pundir B.P., "Engine Emissions: Pollutant Formation and Advances in Control Technology", Narosa Publications.
- Oberts E.F., "Internal Combustion Engine and Air Pollution", Harper and Row Publisher.
- Willard H.H., "Instrumental Method of Analysis", CBS Publishers and Distributors.

- Heywood.J.B., "Internal Combustion Engine Fundamentals", McGraw Hill.
 - "Motor Vehicles Act / Emission Norms", Govt of India Publications.
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BTAE 406 Internal Combustion Engines LAB

L	T	P	Internal Marks:	30
-	-	2	External Marks:	20

1. Study of layout of different components in an IC Engine
 2. Study and draw a valve timing diagram for a 4-stroke multi cylinder engine
 3. Study of valve actuating mechanisms of a multi cylinder engine
 4. Study of different carburetors in Indian make of vehicles
 5. Study of different fuel injection system in Indian make of vehicles
 6. Trouble shooting in an IC engine
 7. Morse test on petrol and diesel engines.
 8. Heat balance test on an automotive engine.
 9. Performance study of IC engine at full throttle and part throttle conditions with alternative fuels and their comparisons
 10. Exhaust emission analysis of an SI and CI engine.
 11. Study of emission control systems on a vehicle.
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BTAE 407 Fluid Mechanics and Machinery LAB

L T P
- - 2

Internal Marks: 30

External Marks: 20

List of Experiments

1. To study the flow through a variable area duct and verify Bernoulli's energy equation.
 2. To determine the coefficient of discharge for an obstruction flow meter (venturi meter/ orifice meter)
 3. To study the transition from laminar to turbulent flow and to ascertain the lower critical Reynolds number.
 4. To determine the hydraulic coefficients for flow through an orifice.
 5. To determine the friction coefficients for pipes of different diameters.
 6. To determine the head loss in a pipe line due to sudden expansion/ sudden contraction/ bend.
 7. To determine the velocity distribution for pipeline flow with a pitot static probe.
 8. To study the constructional features of reciprocating pump and to perform test on it for determination of pump performance
 9. To draw the various characteristics of Centrifugal pump
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BTAE 408 Automotive Electrical Systems LAB

L	T	P	Internal Marks:	30
-	-	2	External Marks:	20

List of Experiments

1. To understand the layout of complete wiring system of an automobile.
2. Perform the various tests for checking the battery condition.
3. To understand and test the charging circuit and charging motor.
4. To conduct performance test on a dynamo, alternator & starter motor.
5. To understand & test the starting circuit and trouble shooting in it.
6. Understand and test the conventional ignition system, setting of contact breaker points and spark plug gap.
7. Understand the working and testing of an Electronic Ignition system
8. Understand and test the lighting circuit of a car.
9. Conduct headlamp focusing as per the procedure.
10. Study the working of different accessories of a modern car
11. To study the layout / working of a Fuel Cell powered electric car.