B. TECH (AUTOMOBILE ENGINEERING)

STUDY SCHEME

BATCH 2018-19 ONWARDS

I.K.G.P.T.U KAPURTHALA

3rd Semester; Contact Hours: 30

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
BTAE301-18	Strength of Materials	3	1	0	4	40	60	100	4
BTAE302-18	Engineering Thermodynamics	3	1	0	4	40	60	100	4
BTAE303-18	Fluid Mechanics and Fluid Machines	3	1	0	4	40	60	100	4
BTAE304-18	Machine Drawing	1	0	6	7	40	60	100	4
BTAE305-18	Automotive Materials	3	0	0	3	40	60	100	3
BTAE306-18	Strength of Materials Lab	0	0	2	2	30	20	50	1
BTAE307-18	Fluid Mechanics and Fluid Machines Lab	0	0	2	2	30	20	50	1
BTAE308-18	Engineering Thermodynamics Lab	0	0	2	2	30	20	50	1
BMPD301-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**30**	**290**	**360**	**650**	**22**

4th Semester; Contact Hours: 30

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
BTAE401-18	Manufacturing Processes	4	0	0	4	40	60	100	4
BTAE402-18	Kinematics and Theory of Machines	3	1	0	4	40	60	100	4
BTAE403-18	Heat Transfer and Combustion	4	0	0	4	40	60	100	4
BTAE404-18	Automotive Electrical and Electronics Systems	4	0	0	4	40	60	100	4
BTAE405-18	Transport Management and Automobile Industry	3	1	0	4	40	60	100	4
EVS101-18	Environment Science	3	0	0	3	100	00	100	Non - credit
BTAE406-18	Manufacturing Processes Lab	0	0	2	2	30	20	50	1
BTAE407-18	Automotive Electrical and Electronics Systems Lab	0	0	2	2	30	20	50	1
BTAE408-18	Kinematics and Theory of Machines Lab	0	0	2	2	30	20	50	1
BMPD401-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**30**	**390**	**360**	**750**	**23**

5th Semester; Contact Hours: 28

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAE501-18	Automotive Chassis system	4	0	0	4	40	60	100	4
BTAE502-18	Numerical Methods	3	1	0	4	40	60	100	4
BTAE503-18	Automotive Petrol and Diesel Engines	3	0	0	3	40	60	100	3
BTAE504-18	Vehicle Body Engineering	4	0	0	4	40	60	100	4
HSMC101-18 /HSMC102-18*	Humanities-I	3	0	0	3	40	60	100	3
BTMC102-18	Essence of Indian Knowledge Traditions	3	0	0	3	100	00	100	Non-Credit
BTAE505-18	Automotive chassis System Lab	0	0	2	2	30	20	50	1
BTAE506-18	Numerical Methods Lab	0	0	2	2	30	20	50	1
BTAE507-18	Vehicle Body Engineering Lab	0	0	2	2	30	20	50	1
BMPD501-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**390**	**360**	**750**	**21**

6th Semester; Contact Hours:

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAE601-18	Vehicle Safety Engineering	4	0	0	4	40	60	100	4
BTAE602-18	Automation Transmission	4	0	0	4	40	60	100	4
BTAE603-18	Design of Automotive Components	3	1	0	4	40	60	100	4
BTAE604-18	Introduction to Industrial Management	3	0	0	3	40	60	100	3
BTAE605-18	Vehicle Maintenance and Diagnostics	4	0	0	4	40	60	100	4
BTAE606-18	Vehicle Maintenance and Diagnostics Lab	0	0	2	2	30	20	50	1
BTAE607-18	Automotive Transmission Lab	0	0	2	2	30	20	50	1
BTAE608-18	Engine Testing & Pollution Measurement Lab	0	0	2	2	30	20	50	1
BTAE609-18	Project -I	0	0	4	4	30	20	50	2
BMPD601-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
	Total				**31**	**320**	**380**	**700**	**24**

The project work will be carried out in parts as minor project in 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 semester. The minor project may be carried out by a group of students 2 to 4.

Semester 7th / 8th

Course Type	Course Code	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
Professional Core courses	BTAE701-18	Vehicle Dynamics	3	1	0	40	60	100	4
Professional Core courses	BTAE702-18	Automotive heating ventilation and air conditioning	4	1	0	40	60	100	5
Professional Core courses	BTAE703-18	Measurement and Instrumentation	3	0	0	40	60	100	3
Professional Elective courses		Elective-I	3	0	0	40	60	100	3
Professional Elective courses		Elective-II	3	0	0	40	60	100	3
	BTAE704-18	Automotive Heating, ventilation and air conditioning lab	0	0	2	30	20	50	1
	BTAE705-18	Measurement and Instrumentation lab	0	0	2	30	20	50	1
	BTAE706-18	Project-II	0	0	8	40	60	100	4
	BMPD	Mentoring and Professional Development	0	0	2	Satisfactory/ un-satisfactory			Non-credit
Total						300	400	700	24

List of Elective –I and Elective-II

1. BTAE707-18 Computer Aided Design and Manufacturing
2. BTAE708-18 Automotive Aerodynamics
3. BTAE709-18 Hydraulic & Pneumatics systems for automobiles
4. BTAE710-18 Tractors & Farms Equipment
5. BTAE711-18 Off Road Vehicles
6. BTAE712-18 Automotive fuels & Emission
7. BTAE713-18 Computation fluid dynamics
8. BTAE714-18 Mechatronics
9. BTAE715-18 Alternate fuels and energy systems

Semester 7th / 8th

Course Code	Course Title	Evaluation Internal		External	Total Marks	Credits
		Institute	Industry			
BTAE-801	Software Training	100	50	100	250	8
	Industrial Training	100	50	100	250	8
	Total	200	100	200	500	16

DETAILED SYLLABUS
FOR 3rd to 8th SEMESTER

3rd Semester; Contact Hours: 30

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
BTAE301-18	Strength of Materials	3	1	0	4	40	60	100	4
BTAE302-18	Engineering Thermodynamics	3	1	0	4	40	60	100	4
BTAE303-18	Fluid Mechanics and Fluid Machines	3	1	0	4	40	60	100	4
BTAE304-18	Machine Drawing	1	0	6	7	40	60	100	4
BTAE305-18	Automotive Materials	3	0	0	3	40	60	100	3
BTAE306-18	Strength of Materials Lab	0	0	2	2	30	20	50	1
BTAE307-18	Fluid Mechanics and Fluid Machines Lab	0	0	2	2	30	20	50	1
BTAE308-18	Engineering Thermodynamics Lab	0	0	2	2	30	20	50	1
BMPD301-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**30**	**290**	**360**	**650**	**22**

BTAE301-18 STRENGTH OF MATERIALS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100s	4

Objectives:

1. To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
2. To calculate the elastic deformation occurring in various simple geometries for different types of loading.

Detailed Contents:

Deformation in solids-Hooke's law, stress and strain-tension, compression and shear stresses-elastic constants and their relations-volumetric, linear and shear strains-principal stresses and principal planes-Mohr's circle. **(8)**

Beams and types, transverse loading on beams-shear force and bending moment diagrams-Types of beam supports, simply supported and over-hanging beams, cantilevers, theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads. **(8)**

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems. **(8)**

Torsion stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs. **(8)**

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure **(8)**

Course Outcomes:

1. After completing this course, the students should be able to recognise various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components
2. The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

Suggested Readings/Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.

2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.

3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw Hill Publishing Co. Ltd., New Delhi 2005.

4. S. S. Rattan, "Strength of Materials", Tata McGraw Hill, New Delhi.

5. R. K. Bansal, "A Text Book of Strength of Materials", Laxmi Publications, New Delhi.

6. D. K. Singh, "Strength of Materials", Ane Books Pvt. Ltd., New Delhi.

7. Sadhu Singh, Strength of Materials, Khanna Publishers, Delhi.

BTAE302-18 ENGINERING THERMODYNAMICS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To learn about of 1st law for reacting systems and heating value offuels
2. To learn about gas and vapor cycles and their first law and second law efficiencies
3. To learn the about reciprocating compressors, refrigeration and air conditioning systems.

Detailed Contents:

Introduction to solid, liquid and gaseous fuels–Stoichiometry, exhaust gas analysis-First law analysis of combustion reactions-Heat calculations using enthalpy tables-Adiabatic flame temperature-Chemical equilibrium and equilibrium composition calculations using free energy. **(8)**

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super-critical and ultra-super-critical Rankine cycle-Gas power cycles, Air standard Otto, Diesel and Dual Cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling-Combined gas and vapor power cycles-Vapor compression refrigeration cycles, refrigerants and their properties. Refrigeration and Air-Conditioning: Principles of refrigeration, air-conditioning and heat pumps, vapour compression and vapour absorption systems, co-efficient of performance, Properties of refrigerants. **(15)**

Properties of dry and wet air, use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point. **(4)**

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, supersaturation- compressible flow in diffusers, efficiency of nozzle and diffuser. **(8)**

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. **(5)**

Course Outcomes:

1. The students will get a good understanding of various practical power cycles and heat pump cycles.
2. They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors
3. They will be able to understand phenomena occurring in high-speed compressible flows
4. The students will be able to understand principal of refrigeration and air conditioning and their applications.

Suggested Readings/Books:

1. Nag. P.K, Engineering Thermodynamics, Tata McGraw Hill Co Ltd., Seventh Edn, 1993.
2. Mayhew and Rogers, Engineering Thermodynamics, Longman Green & Co Ltd., London, E.L.B.S. Edn, 1990.
3. Van Wylen. G.J. and Sonntag. R.E., Fundamentals of Classical Thermodynamics (SI Version) 2nd Edn, 1986
4. D.H. Bacon, Engineering Thermodynamics, Butterworth & Co., London, 1989.
5. M.A. Sadd Thermodynamics for Engineers, Prentice Hall of India Pvt Ltd., 1989

BTAE303-18 FLUID MECHANICS AND FLUID MACHINES

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To learn about the application of mass and momentum conservation laws for fluid flows
2. To understand the importance of dimensional analysis
3. To obtain the velocity and pressure variations in various types of simple flows
4. To analyze the flow in water pumps and turbines.

Detailed Contents:

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, incompressible flow, Bernoulli's equation and its applications. **(9)**

Exact flow solutions in channels and ducts, Couette and Poiseuille flow, laminar flowthrough circular conduits and circular annuli- concept of boundary layer–measures of boundary layer thickness–Darcy Weisbach equation, friction factor, Moody's diagram. **(9)**

Need for dimensional analysis–methods of dimension analysis–Similitude–types of similitude Dimensionless parameters–application of dimensionless parameters–Model analysis. **(6)**

Euler's equation–theory of rotodynamic machines–various efficiencies–velocity components at entry and exit of the rotor, velocity triangles–Centrifugal pumps, working principle, work done by the impeller, performance curves–Cavitation in pumps-Reciprocating pump – working principle. **(8)**

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines-Pelton wheel, Francis turbine and Kaplan turbines, working principles–draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines. **(8)**

Course Outcomes:

1. Upon completion of this course, students will be able to mathematically analyze simple flow situations
2. They will be able to evaluate the performance of pumps and turbines.

Suggested Readings / Books:

1. S.K. Som, G. Biswas and S. Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill Publications, 3rd edition, 2011.
2. D.S. Kumar, "Fluid Mechanics and Fluid Power Engineering", S.K. Kataria and Sons Publishers, 1st Edition, 2009.
3. C.S.P. Ojha, R. Berndtsson and P.N. Chandramouli, "Fluid Mechanics and Machinery", Oxford University Press,1st Edition, 2010.
4. Y.A. Cengel and J.M. Cimbala, "Fluid Mechanics - Fundamentals and Applications", Tata McGraw Hill Publications, 3rd Edition, 2013.
5. Frank M. White, "Fluid Mechanics", Tata Mc Graw Hill Publications, 5th Edition, 2012.

BTAE304-18 MACHINE DRAWING

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
1	0	6	7	40	60	100	4

Objectives:
The student will acquire a knowledge of fastening arrangements such as welding, riveting the different styles of attachment for shaft. The student also is enabled to prepare the assembly of various machine or engine components and miscellaneous machine components; from the individual part drawing.

Note:

1. Drawing Practice is to be done as per IS code SP 46:2003 by Bureau of Indian Standards.
2. The Question paper shall have following structure/weightage:
   Section A – Short answer type Questions based upon whole syllabus – 10 question of 02 marks each (All questions are compulsory).
   Section B – Free hand sketching of machine parts etc.; – out of 03 questions of 05 marks each, 02 Questions are to be attempted.
   Section C – Assembly drawing (from Unit-III) of machine parts with at least two views (with bill of materials) – out of 02 questions of 30 marks each; 01 question is to be attempted.

Detailed Contents:

1. Introduction: Classification of drawings, Principles of drawing, Requirements of machine Drawing, sectional views and conventional representation, dimensioning, concept of limits, fits & tolerances and their representation, machining symbols, various types of screw threads, types of nuts and bolts, screw fasteners, welded joints and riveted joints, introduction and familiarization of code SP 46:2003 by Bureau of Indian Standards. **(15)**

2. Free hand sketches of:

- **a. Couplings**: solid and rigid couplings, protected type flange coupling, pin type flexible coupling, muff coupling.
- **b.** Knuckle and cotter joints.
- **c. Pipe and Pipe fittings**: Flanged joints, spigot and socket joint, union joint, hydraulic and expansion joint. **(15)**

3. Assembly of:

- **a. IC Engine Parts:** piston and connecting rod.
- **b. Boiler Mountings**: Steam stop valve, blow off cock, feed check valve and spring-loaded safety valve.
- **c. Bearing:** Swivel bearing, Plummer Block and Foot Step bearing.
- **d. Miscellaneous:** Screw jack, Tail Stock and crane hook. **(20)**

4. Practice using Computer Aided Drafting (CAD) tools for:

(a) Machine components, screw fasteners, Keys cotters and joint, shaft couplings, Pipe joints and fittings, riveted joints and welded Joints.

(b) Assemblies: - Bearings (Plumber Block, Footstep, Swivel), boiler mountings, screw jack, Exercise in computer Plots of drawing

(c) Case studies in computer plots and industrial blueprint (**10)**

Course Outcomes:

After studying this course; the student will be able to:

1. Read, draw and interpret the machine drawings and related parameters.
2. Use standards used in machine drawings of machine components and assemblies.
3. Learn the concept of limits, fits and tolerances in various mating parts.
4. Visualize and generate different views of a component in the assembly.
5. Use CAD tools for making drawings of machine components and assemblies.

Suggested Reading/Books:

1. P.S Gill, "Machine Drawing", S K Kataria and sons, 18th edition, 2017reprint
2. N.D. Bhatt, "Machine Drawing". Charotar publications, 49th edition,2014
3. Ajeet Singh, "Machine Drawing (including Auto CAD)", Tata McGraw Hill, 2nd edition,2012
4. G. Pohit, "Machine Drawing with Auto CAD", Pearson Education Asia, 2007.
5. IS code SP 46(2003): Engineering Drawing Practice for schools and colleges by Bureau of Indian Standards.

Topic for Self-Learning (TSL)

1. Conventional representation of common feature like Springs, Gear Assembly, Braking of shaft, Pipe, Screw threads etc.
2. Drawing of special Types of bolts, nuts and washers.
3. Importance of bill of materials (BOM)
4. Free hand sketch of bearings (i.e. ball bearing and roller bearing).

BTAE305-18 AUTOMOTIVE MATERIALS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	0	0	3	40	60	100	3

Objectives:
To present a problem oriented in depth knowledge of automotive materials and manufacturing. To address the underlying concepts and methods behind automobile materials and manufacturing including the surface treatment of the materials.

Detailed Contents:
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**.** **(4)**

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**.** **(3)**

Rubber: Introduction, characteristics of rubbers, structure of elastomers, types of elastomers, vulcanization of rubber, uses of rubber and applications. (2)

Plastics Materials: Introduction, definition and concept, properties of plastics, thermoplastics, thermosetting plastics, deformation of plastics, plastic alloys. (2)

Fundamentals of Composites- need for composites–Enhancement of properties -classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Fiber reinforced composites, Applications of various types of composites. (3)

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). (4)

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–aluminum oxide–silicon nitride – reinforcements – particles- fibres whiskers. Sintering - Hot pressing – Cold isostatic presses–Hot isostatic pressing. (4)

Advances in Composites Carbon / carbon composites–Advantages of carbon matrix–limitations of carbon matrix Carbon fibre. (2)

Heat Treatment and Surface Treatment: Heat treatment of steel–Annealing, Normalizing, Hardening and tempering with their types and application to automotive components, (3)

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. (4)

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. (6)

Course Outcomes:

1. The students can identify different areas of automobile materials and manufacturing.
2. The students can find the applications of all the areas in day to day life.

Suggested Readings / Books:

1. Khanna. O.P., "Material Science and Metallurgy ", Dhanpat Rai and Sons.
2. Agarwal B.K., "Introduction to Engineering Materials", Tata McGraw-Hill.
3. Dogra Rakesh, "Advances in Material Science", Katson Books.
4. Mathews F.L. and Rawlings R.D., "Composite Materials", Chapman and Hall, London, England, 1st edition, 1994.
5. Chawla K.K., "Composite materials", Springer – Verlag, 1987.
6. Strong A.B., "Fundamentals of Composite Manufacturing", SME, 1989.
7. Sharma S.C., "Composite materials", Narosa Publications, 2000.
8. Daniel Yesudian C., "Materials Science and Metallurgy", Scitech Publications (India), 2004.

BTAE306-18 STRENGTH OF MATERIALS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Course Outcomes:

After studying this course, students shall be able to:

1. Measure the various mechanical properties such as tensile and compressive strength, impact strength, torsion strength and fatigue strength and hardness of brittle and ductile materials.
2. Calculate load carrying capacity of long columns and their buckling strength.

List of Experiments:

1. To perform tensile and compression test in ductile and brittle materials and to draw stress-strain curve and to determine various mechanical properties.
2. To perform any hardness tests (any one; from Rockwell, Brinell & Vicker's test).
3. To perform impact test to determine impact strength.
4. To perform torsion test and to determine various mechanical properties.
5. To perform Fatigue test on circular test piece.
6. To perform bending test on beam and to determine the Young's modulus and modulus of rupture.
7. Determination of Bucking loads of long columns with different end conditions.

BTAE307-18 FLUID MECHANICS AND FLUID MACHINES

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Course Outcomes:

After studying this course, students shall be able to:

1. Distinguish various type of flows and flow measurement methods and concept of statics and dynamics of liquids.
2. Determine discharge and head loss, hydraulic and friction coefficient, for different types of flow in pipe and open channels.

List of Experiments:

1. To determine the metacentric height of a floating vessel under loaded and unloaded conditions.
2. To study the flow through a variable area duct and verify Bernoulli's energy equation.
3. To determine the coefficient of discharge for an obstruction flow meter (venturi meter/ orifice meter)
4. To determine the friction coefficients, head loss in pipes.
5. To determine the velocity distribution for pipeline flow with a pitot static probe.
6. Determination of various efficiencies of Hydraulic Ram
7. To draw characteristics of Francis turbine/Kaplan Turbine, Pelton Turbine and Centrifugal pump.

BTAE308-18 ENGINEERING THERMODYNAMICS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Course Outcomes:

After studying this course, students shall be able to:

1. Understand the construction and working of IC engines, and evaluate their performance.
2. Understand to prepare the heat balance sheet for IC Engines.

List of Experiments:

1. Study of construction and operation of 2 stroke and 4 stroke Petrol and Diesel engines and to plot actual valve timing diagram of 4 stroke petrol and diesel engines and study its impact on the performance of engine.

2. Determination of dryness fraction of steam and estimation of brake power, Rankine efficiency, relative efficiency, generator efficiency, and overall efficiency of an impulse steam turbine and to plot a Willian's line.

3. Determine the brake power, indicated power, friction power and mechanical efficiency of a multi cylinder petrol engine running at constant speed (Morse Test).

4. Performance testing of a Petrol and Diesel engine from no load to full load (at constant speed) for a single cylinder/ multi- cylinder engine in terms of brake power, indicated power, mechanical efficiency and specific fuel consumption and to measure the exhaust emission. Draw/obtain power consumption and exhaust emission curves. Also make the heat balance sheet.

4th Semester; Contact Hours: 30

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
BTAE401-18	Manufacturing Processes	4	0	0	4	40	60	100	4
BTAE402-18	Kinematics and Theory of Machines	3	1	0	4	40	60	100	4
BTAE403-18	Heat Transfer and Combustion	4	0	0	4	40	60	100	4
BTAE404-18	Automotive Electrical and Electronics Systems	4	0	0	4	40	60	100	4
BTAE405-18	Transport Management and Automobile Industry	3	1	0	4	40	60	100	4
EVS101-18	Environment Science	2	0	0	2	Non-Credit Mandatory Course			
BTAE406-18	Manufacturing Processes Lab	0	0	2	2	30	20	50	1
BTAE407-18	Automotive Electrical and Electronics Systems Lab	0	0	2	2	30	20	50	1
BTAE408-18	Kinematics and Theory of Machines Lab	0	0	2	2	30	20	50	1
BMPD401-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**30**	**290**	**360**	**650**	**23**

BTAE401-18 MANUFACTURING PROCESSES

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Detailed Contents:

Conventional Manufacturing processes: Casting and Moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. **(5)**

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy. **(4)**

Metal Cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, cutting tool materials, cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining. **(8)**

Additive Manufacturing: Rapid prototyping and rapid tooling. **(3)**

Joining/Fastening Processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding. **(4)**

Unconventional Machining Processes:

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters. **(5)**

Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant &maskant, process parameters, MRR and surface finish. **(8)**

Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining. **(3)**

Course Outcomes:

Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products

Suggested Readings/Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
3. Degarmo, Black & Kohser, Materials and Processes in Manufacturing

BTAE402-18 KINEMATICS AND THEORY OF MACHINES

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To understand the kinematics and rigid- body dynamics of kinematically driven machine components.
2. To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link.
3. To be able to design some linkage mechanisms and cam systems to generate specified output motion and to understand the kinematics of gear trains.

Detailed Contents:

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains-Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms **(8)**

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics Coincident points- Coriolis component of acceleration- introduction to linkage synthesis three position graphical synthesis for motion and path generation **(8)**

Classification of cams and followers- Terminology and definitions- Displacement Diagrams-Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers **(8)**

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics **(8)**

Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication friction clutches- belt and rope drives- friction in brakes **(8)**

Course Outcomes:

The students can design various types of linkage mechanisms for obtaining specific motion and analyse them for optimal functioning.

Suggested Readings/Books:

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2. Cleghorn W.L., Mechanisms of Machines, Oxford University Press, 2005.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill, 2009.
4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.

BTAE403-18 HEAT TRANSFER AND COMBUSTION

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Objectives:

1. The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
2. Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
3. The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers

Detailed Contents:

Conduction: Fourier law of heat conduction for isotropic material. Thermal conductivity. Derivation of the energy equation in three dimensions including transient effect, Non dimensional-thermal diffusivity and Fourier number, Types of boundary conditions- (Dirchlet, Neumann, mixed type), One-dimensional solution with and without heat generation, Analogy with electrical circuits. (10)

Fins: rectangular and pin fins. Fin effectiveness and efficiency. Critical thickness of insulation. (2)

Radiation: Physical mechanism of thermal radiation, laws of radiation, definition of black body emissive power, intensity of the radiation, emissivity, reflectivity, transmittivity, irradiation, radiosity. Radiation exchange between black bodies. Concept of Gray-Diffuse Isotropic (GDI) surface. Radiation exchange between GDI surfaces. (8)

Convection: Introduction, Newton's law of cooling and significance of the heat transfer co-efficient. Momentum and energy equations in two dimensions, non-dimensional, importance of non-dimensional quantities and their physical significance. Order of magnitude analysis for flow over a flat plate. Velocity and Analogies between momentum, heat and mass transfer. Natural convection. (9)

Heat exchangers: Types of heat exchangers, parallel and counter flow types, Introductions to LMTD. Correction factors, fouling factor. (4)

Combustion Analysis: Fuels, HCV and LCV, Air requirements, excess air, analysis of products of combustion. Enthalpy of formation, adiabatic flame temperature, enthalpy of combustion, heat of reaction. Analysis of fuels and flue gas, Orsat's apparatus. (7)

Course Outcomes:

1. After completing the course, the students will be able to formulate and analyze a heat transfer problem involving any of the three modes of heat transfer.
2. The students will be able to obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer
3. The students will be able to design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.

Suggested Readings/Books:

1. A. Bejan, Heat Transfer John Wiley, 1993
2. J.P. Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3. F.P. Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.

4. Massoud Kaviany, Principles of Heat Transfer, John Wiley, 2002
5. Yunus A Cengel, Heat Transfer: A Practical Approach, McGraw Hill, 2002
6. D.S. Kumar. Heat and Mass Transfer, S.K. Kataria & Sons, 2013

BTAE 404-18 AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEMS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Objectives:

The students should be able to

1. Acquire the knowledge of Electrical and Electronics engineering concepts.
2. Understand the construction and applications of Electrical and electronics components in various automotive electrical circuits.
3. Understand the construction and working of various automotive electrical systems and components.
4. Identify, demonstrate and compare the various components and systems of Auto electrical systems.

Detailed Contents:

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. (2)

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. (4)

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. (3)

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. (3)

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. (5)

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, rear-plate lamps. Automatic illumination system, head light leveling devices. Study of a modern headlight system with improved night vision. (4)

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. (4)

Fuel Cells Thermodynamic aspects; types-hydrogen and methanol, power rating and performance, various components and working of fuel cell, heat dissipation. (2)

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 (2)

Basic electronics: Semiconductors- P type-N type, diode-introduction-half wave rectification-full wave bridge rectifier-full wave bridge rectifier with capacitor filter, zener diode-introduction, zener diode as voltage regulator, LED and photo diode-introduction-applications, transistor-introduction NPN and PNP transistor-applications-transistor as switch. (7)

Course Outcomes:

After studying this course, students shall be able to:

1. Explain basic terminologies, components and concepts of electrical and electronics engineering.
2. Understand the purpose, construction and working of different batteries, electrical systems, components of charging and starting system used in Automobiles.
3. Understand purpose, circuits, construction and working of components of ignition system, lighting and accessories system.
4. Explain purpose, circuits, construction and working of components of lighting and accessories system.

Suggested Readings/Books:

1. Kohli P.L., “Automotive Electrical Equipment ", Tata McGraw-Hill.
2. Chapman, “Principles of Electricity and Electronics for the Automotive Technician”, Thomson Asia, 2000.
3. Judge A.W., "Modern Electrical Equipment of Automobiles", Chapman & Hall, London.
4. Vinal G.W., "Storage Batteries ", John Wiley & Sons Inc.
5. W.H. Crouse, “Automobile Electrical Equipment ", McGraw Hill Book Co. Inc.

BTAE405-18 TRANSPORT MANAGEMENT AND AUTOMOBILE INDUSTRY

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To learn about management training and operations
2. To learn about vehicle maintenance and vehicle parts.
3. To learn the about motor vehicle acts.

Detailed Contents:

Management Training and Operations: Basic principles of supervising. Organizing time and people. Job instruction training, training devices and techniques. Driver and mechanic hiring. Driver checklist, Lists for driver and mechanic. Trip leasing. Vehicle operation and types of operation. Automobile Industry: History and development of the automobile industry, market trends, current scenario in Indian auto industry, Auto ancillary industries, Role of the automobile industry in national growth. (10)

Vehicle Maintenance: Scheduled and unscheduled maintenance Planning and scope. Evaluation of PMI program, Work scheduling, Overtime, Breakdown analysis, Control of repair backlogs, Cost of options.

Scheduling and Fare Structure: Route planning, Scheduling of transport vehicles, Preparation of timetable, Costs, fare structure, methods of the fare collection, Preparation of fare table. (10)

Vehicle Parts, supply management and budget: Cost of inventory, balancing inventory cost against downtime, Parts control, Bin tag systems, Time management, Time record keeping, Budget activity, Capital expenditures, Classification of vehicle expenses, Fleet management and data processing, Data processing systems- Software, Models–Computer controlling of fleet activity, energy management. (10)

Motor Vehicle Act: Schedules and sections, Registration of motor vehicles, Licensing of drivers, Control of permit, Limits of speed, traffic signs. Constructional regulations. Description of goods carrier, delivery van, tanker, tipper, Municipal, firefighting and break down service vehicle. (8)

Course Outcomes:

After completing this course, the students will get a good understanding of various management training operations and will able to understand vehicle maintenance techniques and methodologies. They will be able to understand supply management and budget for the production. They will be able to understand the motor \vehicle acts.

Suggested Readings/Books:

1. John Dolu, Fleet Management, McGraw Hill Co., 1984
2. Government Publication, The Motor Vehicle Act, 1989
3. Kitchin. L. D., Bus Operation, IIIiffe and Sons Ltd., London, III Edition, 1992
4. Kadiyali. L.R., Traffic Engineering and Transport Planning.

EVS101-18 ENVIRONMENT SCIENCE

L	T	P	Total	Credit points
3	0	0	3	Non-Credit

Objectives:

1. To learn about management training and operations
2. To learn about vehicle maintenance and vehicle parts.
3. To learn the about motor vehicle acts.

Detailed Contents:

Module 1: Natural Resources: Renewable and non-renewable resources

Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resource for sustainable lifestyles.

Module 2: Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystems:

a. Forest ecosystem
b. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Module 3: Biodiversity and its conservation

- Introduction – Definition: genetic, species and ecosystem diversity.
- Biodiversity at global, National and local levels.
- Inida as a mega-diversity nation
- Hot-sports of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India

Module 4: Social Issues and the Environment

- From Unsustainable to Sustainable development
- Resettlement and rehabilitation of people; its problems and concerns.
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, Nuclear accidents and holocaust. Case Studies.

- Public awareness.

***ACTIVITIES**

Nature club (bird watching, recognizing plants at institute/at home, recognizing local animals, appreciating biodiversity. Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

I. Identify a tree fruit flower peculiar to a place or having origin from the place.
II. Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).
III. Videography/ photography/ information collections on specialties/unique features of different types of common creatures.
IV. Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

1*(A) Awareness Activities:*

a) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
b) Slogan making event
c) Poster making event
d) Cycle rally
e) Lectures from experts
f) Plantation
g) Gifting a tree to see its full growth
h) Cleanliness drive
i) Drive for segregation of waste
i) To live with some eminent environmentalist for a week or so to understand his work vi) To work in kitchen garden for mess
j) To know about the different varieties of plants
k) Shutting down the fans and ACs of the campus for an hour or so
l) Visit to a local area to document environmental assets river/forest/grassland/hill/mountain/lake/Estuary/Wetlands
m) Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
n) Visit to a Wildlife sanctuary, National Park or Biosphere Reserve

Course Outcomes:

Students will enable to understand environmental problems at local and national level through literature and general awareness. The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues.

Suggested Readings

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email: mapin@icenet.net (R)
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
4. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p

BTAE406-18 MANUFACTURING PROCESSES LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Course Outcomes:

After studying this course, students shall be able to:

1. Understand the basics of various welding process and will be able to prepare joints using welding process i.e. MIG, Arc welding and spot welding.
2. Understand the working of various machines.

List of Experiments:

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.
4. 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 d) Lathe e) Shaper
5. Industrial Visit for demonstration of Machines

BTAE407-18 AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Course Outcomes:

After studying this course, students shall be able to:

1. Understand the construction and applications of Electrical and electronics components in various automotive electrical circuits.
2. Understand the construction and working of various automotive electrical systems and components.

List of Experiments:

1. To study of rectifier and filters
2. Testing of starting motors and generators
3. To Study of SCR and IC timer, D/A and A/D.
4. Diagnosis of ignition system faults
5. Study of Automobile electrical wiring.
6. Study of logic gates, adder and flip-flops
7. Interfacing A/D converter and simple data acquisition
8. Micro controller programming and interfacing

BTAE408-18 KINEMATICS AND THEORY OF MACHINE LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Course Outcomes:

After studying this course, students shall be able to:

1. Determine gyroscopic couple, balancing of rotating masses and Cam profile analysis.
2. Determine gear- train value of compound gear trains and epicyclic gear trains.

List of Experiments:

1. Conduct experiments on various types of governors and draw graphs between height and equilibrium speed of a governor.
2. Determination of gyroscopic couple (graphical method).
3. Balancing of rotating masses (graphical method).
4. Cam profile analysis (graphical method)
5. Determination of gear- train value of compound gear trains and epicyclic gear trains.
6. To draw circumferential and axial pressure profile in a full journal bearing.

5th Semester; Contact Hours: 28

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAE501-18	Automotive Chassis system	4	0	0	4	40	60	100	4
BTAE502-18	Numerical Methods	3	1	0	4	40	60	100	4
BTAE503-18	Automotive Petrol and Diesel Engines	3	0	0	3	40	60	100	3
BTAE504-18	Vehicle Body Engineering	4	0	0	4	40	60	100	4
HSMC101-18 /HSMC102-18*	Humanities-I	3	0	0	3	40	60	100	3
BTMC102-18	Essence of Indian Knowledge Traditions	3	0	0	3	100	00	100	Non-Credit
BTAE505-18	Automotive chassis System Lab	0	0	2	2	30	20	50	1
BTAE506-18	Numerical Methods Lab	0	0	2	2	30	20	50	1
BTAE507-18	Vehicle Body Engineering Lab	0	0	2	2	30	20	50	1
BMPD501-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**390**	**360**	**750**	**21**

BTAE501-18 AUTOMOTIVE CHASSIS SYSTEMS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
4	0	0	4	40	60	100	4

Detailed Contents:

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 axle 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.

Suggested Readings/Books:

1. Reimpell and Betzler, “The Automotive Chassis: Engineering Principles”, Second Edition Butterworth Heinemann London.
2. Giancarlo Genta, “The Automotive Chassis volume I and volume II”, Springer.
3. Heinz Heisler, “Advanced Vehicle Technology”, Second Edition Butterworth Heinemann London.
4. Gilles T., “Automotive Chassis Brakes Steering and Suspension”, Thomson USA.
5. Newton Steeds and Garrot, “Motor vehicles ", Butterworths, London.
6. Judge A.W., “Mechanism of the car ", Chapman and Halls Ltd., London.

BTAE502-18 NUMERICAL METHODS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
3	1	0	4	40	60	100	4

Course objectives:
This course deals with the basic concepts of mathematical statistics and numerical analysis. The objective of this course is to introduce these concepts and focus on application of these for handling the problems arising in science, engineering and technology.

Course Outcomes:
After completing the course, the students will be able to

1. Apply the concepts of mathematical statistics in modeling processes and decision making.
2. Apply the concepts of numerical methods for solving problems arising in science, engineering and technology.
3. Solve continuous problems numerically which are difficult to deal with analytically.

Detailed Contents:

Unit-I

Probability and Probability Distributions: Population, Sample space, Events, Random Variables; Definitions of probability, conditional Probability, expectation, Binomial, Poisson and Normal distributions.

Testing of Hypothesis: Types of Error, Power of a test, Goodness of a fit, Student t and Chi-Square tests.

Unit-II

Floating-Point Numbers: Floating-point representation, Rounding, Chopping, Error Analysis. Condition and instability.

Solution of Algebraic and Transcendental Equations: Errors in numerical computation, bisection method, Newton-Raphson's method and method of false position, System of nonlinear equations: Newton-Raphson's method.

Unit-III

Linear System of Equations: Gauss elimination method and Gauss Jordan method. Eigenvalue Problem: Power Method.

Interpolation: Interpolation with Unevenly Spaced Points: Lagrange Interpolation, Newton's Divided Difference Interpolation; Interpolation with Evenly Spaced Points: Newton's Forward Difference Interpolation Formula, Newton's Backward Difference Interpolation Formula, Spline interpolation

Unit-IV

Numerical Differentiation and Integration: Numerical differentiation: Newton's Forward Difference Formula, Newton's Backward Difference Formula, Newton's Divided Difference Formula; Numerical Integration: Trapezoidal rule, Simpson's 1/3-rule and Simpson's 3/8 rule.

Numerical solution of ordinary differential equations (ODEs):
Initial Value Problems of ODEs: Taylor series method, Euler's methods, Runge-Kutta methods and linear multi-step methods (Adams-Bashforth & Adams-Moulton).

Text/Reference Books:

1. Gupta S.C., Kapoor V.K. (2014), Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi.
2. Jain M. K., Iyengar S. R. K, Jain R. K. (2007), Numerical methods for Scientific and Engineering Computation, New Age International Publishers, New Delhi.
3. Sastry S. S. (2012), Introductory Methods of Numerical Analysis, Prentice Hall of India, Delhi.

BTAE503-18 AUTOMOTIVE PETROL AND DIESEL ENGINES

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
3	0	0	3	40	60	100	03

Detailed Contents:

Fundamentals Engine terminology, classification. Working principle of two stroke and four stroke engines, 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.

Modern technologies in I.C. engines: HCCI Engines – construction and working, CRDi injection system, GDI

Technology, E - Turbocharger, Variable compression ratio engines, variable valve timing technology, Hybrid vehicle Technology

Suggested Readings/Books:

1. Ganesan.V., “Internal Combustion Engines ", Tata-McGraw Hill.
2. Ramalingam K.K., "Internal Combustion Engines Theory and Practice", Scitech Publications (India).
3. Gupta H.N., “Fundamentals of Internal Combustion Engines”, PHI Learning.
4. Willard W. Pulkrabek, “Engineering fundamentals of the Internal combustion engine”, Pearson Prentice Hall.
5. Maleev.V.M., “Diesel Engine Operation and Maintenance ", McGraw Hill.
6. William H. Crouse, “Automotive Engines ", McGraw Hill.
7. Hua Zhao, “HCCI and CAI engines for the automotive industry”, Woodhead Publishing

BTAE504-18 VEHICLE BODY ENGINEERING

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
4	0	0	4	40	60	100	4

Detailed Contents:

Introduction: Classification of automobiles on different basis, Types of vehicle bodies, requirements of automobile body, constructional details.
Car body details: Types: Saloon, hatchback, convertibles, Limousine, Estate Van, racing and sports car, etc. Car body construction types – frame and unitary (monocoque), various body panels and their constructional details
Bus body details: Types: Mini bus, single and double Decker, split level and articulated bus, Bus body lay out, Floor height, Engine location, Entrance and exit location, Seating dimensions, Constructional details: Frame construction, Double skin construction, Types of metal section used, Regulations, Conventional and integral type construction.
Commercial vehicle details: Types of commercial vehicles. Commercial vehicle body details, flat platform, drop side, fixed side, tipper body, tanker body, tractor trailer.
Body loads: Idealized structure, structural surface, shear panel method, symmetric and asymmetric vertical loads in a car, longitudinal load, and different loading situations.
Body materials, trim and mechanisms: Carbon fibers, plastics, timber, GRP; ferrous and non-ferrous materials used in vehicle. Corrosion and anticorrosion method. Paint and painting process, Corrosion, Anticorrosion methods, Body trim items, Body mechanisms.
Special Purpose vehicle details: Various types, Needs and constructional details - Fire station vehicle, tankers, pumping vehicles, ladder vehicle, Concrete mixer transport vehicles; Ambulance, Towing vehicle, Road trains, Off road vehicles, cement trucks.
Safety in vehicle design: Basics of impacts protection, design for crashworthiness, front impact and side impact analysis, bumper system, energy absorbent forms. Indian Motor acts and its application- The motors vehicle acts 1988, Driving license, Registration of vehicles, Rules of the road, Motor Insurance.

Suggested Readings/Books:

1. J Powloski, “Vehicle Body Engineering”, Business Books Ltd., London.
2. Kirpal Singh, “Automobile Engineering Vol-1”, Standard Publishers distributors
3. Braithwaite J.B., “Vehicle Body building and drawing ", Heinemann Educational Books Ltd., London.
4. Sydney F. Page “Body Engineering” Chapman & Hill Ltd., London,
5. John Fenton, “Handbook of Automotive Body and Systems Design”, Wiley.
6. Heinz Hezler “Advance vehicle Technology”

BTAE505-18 AUTOMOTIVE CHASSIS SYSTEMS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

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

BTAE506-18 NUMERICAL METHODS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

List of Experiments:

1. Make a program of bisection method for solving algebraic/transcendental equations and implement it on some problems.
2. Develop a program of Newton-Raphson's method for solving algebraic/transcendental equations and implement it on some problems.
3. Develop and implement a program of Method of False Position for solving algebraic/transcendental equations.
4. Develop and implement a program of Gauss-elimination method for solving a system of linear equations.
5. Develop and implement a program of trapezoidal rule to approximate a definite integral.
6. Develop and implement a program of Simpson's rule to approximate a definite integral.
7. Develop and implement a program of Euler's method for solving initial value problems of ordinary differential equations.
8. Develop and implement a program of fourth order Runge-Kutta method for solving initial value problems of ordinary differential equations.
9. Develop and implement a program of two-step Adams-Bashforth method for solving initial value problems of ordinary differential equations.
10. Develop and implement a program of two-step Adams-Moulton method for solving initial value problems of ordinary differential equations.

Note. Use any programming language/computer algebra system to develop and implement the following programs.

BTAE 507-18 VEHICLE BODY ENGINEERING LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

List of Experiments:

1. Study of typical car body construction and propose new design sketches.
2. Study driver's seat position, passenger seat position, its requirement and construction of typical truck/bus body and propose new design sketches.
3. To prepare the analysis of the vehicle body weight and the weight distribution in different conditions and its effect on tractive performance.
4. Measurement of drag, lift force of a scaled model in wind tunnel
5. Study the anti-corrosion and body painting and repainting procedures.
6. Study the construction of a special purpose vehicle.
7. To prepare the analysis of the vehicle body weight and the weight distribution in different conditions and its effect on steering performance.

BTAE 601-18 VEHICLE SAFETY ENGINEERING

L	T	P	Internal Marks: 40
4	0	-	External Marks: 60

Course Objectives:	
1	To broaden the understanding of role of safety systems in automobiles
2	To introduce vehicle structural crashworthiness and crash testing
3	Identify different safety systems and its role in automobiles

CO	Course Outcomes
CO-1	**Understand** the concept of crumple zone, safety sandwich construction and monocoque chassis construction.
CO-2	**Illustrate** different safety concepts including active and passive safety.
CO-3	**Understand** the working of ABS, EBD and other safety equipment's
CO-4	**Interpret** the concept of collision warning and avoidance systems
CO-5	**Summarize** various comfort and convenience systems.

1. **Introduction:** Design of the body for safety, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumple zone, safety sandwich construction, monocoque chassis construction.
2. **Safety Concepts:** Active safety: driving safety, conditional safety, perceptibility safety, operating safety, passive safety: exterior safety, interior safety, deformation behavior of vehicle body, and speed, stopping distance.
3. **Safety Equipment's:** Seat belt, regulations, automatic seat belt tightening system, collapsible steering column, tilt-able steering wheel, air bags, electronic system for activating air bags, bumper design for safety, Anti-lock Braking System (ABS), introduction to Electronic Stability Programme (ESP) & Electronic Brake Force Distribution (EBD).
4. **Collision Warning and Avoidance**: Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions, pedestrian detection.
5. **Comfort And Convenience System:** Steering and mirror adjustment, central locking system, Garage door opening system, tyre pressure control system, rain sensor system, environment information system.

Book:

1. Bosch, "Automotive Handbook" - 5th edition - SAE publication;2000.
2. J.Powloski - "Vehicle Body Engineering" - Business books limited, London;1969.
3. Ronald. K. Jurgen - "Automotive Electronics Handbook" - Second edition- McGraw Hill Inc.; 1999.
4. Hucho. W.H. - "Aerodynamic of Road Vehicles" - Butterworths Co., Ltd.;1997.

BTAE-602-18 AUTOMOTIVE TRANSMISSIONS

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

Course Objectives:	
1	On completion of this course, the student will know about the clutch, gearbox, hydrodynamic drives, automatic transmission, hydrostatic drive and electric drive-in automobiles, their principle of operation and performance.
2	To provide the knowledge about the components and operation of manual and automatic transmissions

CO	Course Outcomes
CO-1	**Recognize** the need for automotive transmission system and their classification.
CO-2	**Understand** operation, constructional details, and design aspects of various types of clutches and gears.
CO-3	Study and **distinguish** between hydrodynamic drive and hydrostatic drive.
CO-4	Know about principle and performance characteristics of electric drives.
CO-5	**Illustrate** Automatic transmission and applications

1. Introduction: Need for Transmission system, Tractive effort and resistances to Motion of a Vehicle, Requirements of transmission system, Classification of Transmission systems, Different Wheel drive systems (Single, Two and Four), Drives (Belt, Chain, Shaft, Hydraulic and Electric drives), Multi-axle drives, Location of transmission system, Different Transmissions units in scooter, car, MUVs and different transport vehicles of Indian make.

2. Clutch: Principle of operation, Constructional details, torque capacity and design aspects of different types of clutches, Operation of single plate: helical spring and diaphragm type, and multi-plate clutch, Centrifugal and Automatic Clutches, Dry and Wet type of clutch, Friction lining materials, Over-running clutches, Modes of Operating clutch – mechanical, hydraulic and electric, Dual Clutch transmission.

3. Gear box: Determination of gear ratios for vehicles, Different types of gearboxes – sliding, constant and synchromesh type, need for double declutching and working of synchronizing unit, Power and economy modes in gearbox, Transfer box, Transaxles, Overdrives, Gear shifting mechanisms – mechanical link and wire types, Paddle shift.

4. Hydrodynamic drive: Fluid coupling- principle of operation, constructional details, Torque capacity, Performance characteristics, Reduction of drag torque, Torque converter, converter coupling- Principle of operation, constructional details & performance characteristics.

5. Hydrostatic drive: Hydrostatic drive, various types of hydrostatic systems, Principles of hydrostatic drive system, Advantages and limitations, Comparison of hydrostatic drive with hydrodynamic drive, Construction and working of typical Janny hydrostatic drive.

6. Electric drive: Electric drive, Principle of early and modified Ward Leonard Control system, Advantage & limitations, Performance characteristics.

7. Automatic transmission & applications: Block diagrams of- Chevrolet "Turbo-glide" Transmission, Power-glide Transmission & Clutch Hydraulic Actuation system, Introduction to Toyota "ECT-i" Automatic Transmission with Intelligent Electronic controls system.

Books:

1. Singh Kirpal, “Automobile Engineering Vol-1”, Standard Publishers distributors.
2. Jaiganesh S., “Automotive Transmissions”, (moallemy.persiangig.com/.../AUTOMOTIVE

TRANSMISSION.pdf)
3. Newton and Steeds, "Motor vehicles ", llliffe Publishers.
4. Judge. A.W., "Modern Transmission systems ", Chapman and Hall Ltd.
5. Crouse. W.H., Anglin, D.L., "Automotive Transmission and Power Trains construction", McGraw-Hill.

BTAE-603-18 DESIGN OF AUTOMOTIVE COMPONENTS

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

Course Objectives:	
1	An understanding of professional, ethical, and economic issues and responsibilities.
2	An ability to analyze a problem, identify and define the computing requirements appropriate to its solution
3	An ability to apply knowledge of computing and mathematics appropriate to information technology.
4	An ability to apply the knowledge of engineering and management principles to effectively manage projects in diverse environments as a member/leader in the team.

CO No.	Course Outcomes
CO-1	Be proficient in applying the knowledge of engineering principles in product design process and systematic design conceptualization.
CO-2	Be able to understand the underlying principles of design in Aesthetics and ergonomics and various manufacturing considerations in designing a component from economic point of view.
CO-3	Be able to design components like braking systems, gears, springs, clutches, and flywheels.
CO-4	Be proficient in analysing various design problems and to identify the parameters required for the solution of the design related problems.
CO-5	Be able to apply the knowledge of mathematical concepts to solve the design related problems.

1. Meaning of design: Definition and understanding of various types of design, Elaborated Design process.

2. Design and creativity: Systematic design conceptualization, product design definition & manufacturing considerations in design, underlying principles of design in Aesthetics and ergonomics, free body diagram for components design.

3. General Design Considerations: Theory of Failure, Selection of materials, Basic criteria of selection of material for automotive parts like piston, cylinder, connecting rod, crankshaft and camshaft, mechanical properties of those materials in brief. Study of Stress concentration, factor of safety under different loading conditions,

4. Design against Static Loading: Bolted Joints- Understanding the various stresses/ failure in bolted joints, basic and eccentrically loaded bolts, Welded Joints- Design for various loading conditions in torsion, shear, or direct loads.

5. Design against Fluctuating Loading: Design of automobile coupling & Springs, Flywheel, Braking Systems, self-energizing brakes, shoe brakes - internal & external expanding, band brakes and disc brakes.

6. Transmission: Clutch-Design considerations for single plate clutch, centrifugal clutch, cone clutch, energy dissipated, torque transmission capacity of clutch. Gears - Design of spur, helical and straight bevel gears, Final Drive- Design consideration for different types of propeller shafts & rear axles. Bearing - Basics of bearings, their types, nomenclature, and Selection criteria.

Books:

1. Singh Kirpal, "Automobile Engineering Vol-1", Standard Publishers distributor's;

2. Automotive Mechanics by Giri. N.K, Khanna Publisher,
3. Fundamental of Machine component design by Juvenal R.C, John Wiley, PSG Design Data book by PSG College of Technology,
4. J.A. Charles – Selection & use of engineering materials –Butterworth –Heinemann;
5. V.B. Bhandari- Design of Machine Elements –Mc Graw Hill, ED
6. Mechanical Engg. Design by Joseph Edward Shigley.

BTAE604-18 INTRODUCTION TO INDUSTRIAL MANAGEMENT

Course objectives:

- To help the students gain understanding of the functions and responsibilities of industrial managements.
- To enable them to analyze and understand the environment of the organization.
- To help the students to develop cognizance of the importance of management principles.
- To provide them tools and techniques to be used in the performance of the managerial job.

Detailed Contents:

Unit-1: Concept of industrial engineering, Roles of industrial engineer, Tools of management science, Introduction to quality, Excellence in manufacturing, Excellence in service, factors of excellence, relevance of total quality management.
Unit-II: Concept of production, Production system, Input output model, definition of quality, Total quality control and Total Quality Management, salient features of total quality control and total quality management, benefits of total quality management.
Unit-III: Introduction to product design, Effect of design on cost, Requirements of a good product design, Factors affect product design, Product life cycle, Need and concept of product planning, Concept of product development. Introduction of industrial cost, Elements of cost, Breakeven analysis.
Unit-IV: Materials management, Purchasing, Objectives of purchasing, Activities, duties and functions of purchasing department, Purchase organizations, Buying techniques, Purchasing procedure.
Unit-V: Concept of plant maintenance, Objectives and importance of plant maintenance, Duties, functions and responsibilities of plant maintenance department, Organization of maintenance, Scheduled, preventive and predictive maintenance.
Unit-VI: Inventory, Inventory control, Objectives of inventory control, ABC analysis, Just-in-time (JIT), Definition: Elements, benefits, equipment layout for JIT system, Waste elimination, workers involvement through JIT: JIT cause and effect chain, JIT implementation.
Unit-VII: Benchmarking: Meaning of benchmarking and its concept, Definition of benchmarking, Benefits of bench marking, process and types of benchmarking.

Unit-VIII: Customer: Types of customers, Customer satisfaction, Role of marketing, Data collection, Customer complaints, Redressal mechanism.

Course Outcomes:

- Understand the complexities associated with management in the organizations and integrate the learning in handling these complexities.
- Demonstrate the roles, skills and functions of management.
- Understand the concepts related to industrial management.

Text Books:

1. Industrial Engineering and Management/ O. P. Khanna/ Dhanpat Rai and Sons
2. General and Industrial Management/ H Fayol/ Pitman
3. Industrial Management/ I. K. Chopde and A. M. Sheikh/ S. Chand
4. A Text Book of Industrial Management/ A. P. Verma and N. Mohan/ Katson

Total Quality Management/ Jeol E. Ross/ Taylor and Francis Limited.

BTAE 605-18 VEHICLE MAINTENANCE & DIAGNOSTICS

L T P — Internal Marks:40
4 0 - — External Marks:60

Course Objectives:	
1	To acquire knowledge about basic maintenance principle of vehicle
2	To diagnose automotive systems and engine using various techniques.
3	To develop maintenance schedule and understand principles of condition-based maintenance.
4	To select appropriate vehicle maintenance tools and equipment's.

CO	Course Outcomes
CO-1	**Apply** the knowledge of engineering fundamental to the solution of problems occurring in different parts and systems of the vehicle.
CO-2	**Identify** and **formulate** the problems occurring in different systems of the vehicle by learning proper inspection and motoring methods.
CO-3	**Select,** and **apply** appropriate techniques and tools for the repair and diagnostics of the vehicles.
CO-4	**Develop** the schedule for the maintenance problems occurring in automotive systems and components like engine, clutch, suspension, steering and brakes.
CO-5	Utilize the gained knowledge as lifelong learning practice and **select** the safe practices and procedures for the maintenance of vehicles with advanced technology.

1. Introduction: Maintenance Objectives, classification, preventive, running and breakdown maintenance, maintenance schedules, workshop manuals, owner's manual, Warranty Procedures, pre-delivery inspection (PDI): front manager, service advisor: functions and duties.

2. Condition Based Maintenance (Cbm): Benefits, Objectives, Principles, what and when to monitor, Techniques, manual inspections, performances monitoring, vibration monitoring, oil debris spectroscopy, thermography and corrosion monitoring, Reliability centered maintenance (RCM), logic, benefits evaluations.

3. Vehicle Maintenance Tools And Equipments: Specifications of standard tools, non-Standard tools, denting tools, painting equipment, testing equipment's, Service station equipment's, Hydraulic lift, Tyre changer, Tyre inflation gauge, Car Washer, Air Compressor, Spark Plug Cleaner and Tester, brake and transmission bleeding equipment, Grease Guns, Hydraulic Hoist, Analyzers: CO, HC, NOx, smoke meter, Engine analyzer- Petrol and Diesel, Ignition timing light, Wheel Balancer, Wheel aligner, Headlight aligner, Cylinder boring and honing, crankshaft grinder, Brake lathe m/c, ridge cutter and boring m/c, Trolley Jacks, Engine lifting cranes.

4. Maintenance Schedule: Difference between chassis and ball bearing grease, use of lubricants: SAE 20 -30, SAE 40-50, SAE 90-120, Machine oil, Brake fluid, Lubrication and maintenance schedules for clutch system, Gear Box, Propeller shaft, universal joints, differential, axles, wheel bearings, tires, Cooling and lubrication system, Specification of petro / diesel Engine, Engine Troubles and Diagnosis.

5. Engine Tuning: S.I Engine tuning; use of compression gauge, vacuum gauge, engine analyzer, exhaust analyzer, battery tester S.G tester, Cam-dwell angle, valve tappet clearance, replacement of engine oil and filter, ignition timing setting, Tyre inflation pressure, checking fuel consumption, MPFI and CRDI, Engines: assembly line diagnostic link (ALDL) connector, ALDL read out scan tool, test light, ohmmeter, digital volt meter, jumper wires, vacuum gauge, Tachometer, computerized automotive

maintenance system. Knowledge of diagnostic codes, service engine soon (SES) light, ECM, CALPAK, TPS, IAC valve, ECM, MAP sensor, engine coolant temp sensor, IAT sensor, VSS, camshaft and Crankshaft – position sensor, start signal, PSP switch, Oxygen sensor, Fuel Vapour Cannister, Catalytic Converter, Particulate filter, Troubles and diagnosis MPFI engines.

6. Clutch, Drive Line, Suspension, Steering and Brakes: Disassembly, cleaning, visual inspection; inspection by measurement and assembly of clutch; gearbox; universal joints; propeller shaft; differential; axles; steering and suspension system (leaf spring and McPhearson strut); Drum and disc Brakes; bleeding of brakes; Gaps and Clearances. Tyre maintenance and wheel balancing; service limits and wheel alignment

7. Engine Overhauling: Procedure for engine removal from vehicle; disassembly; cleaning procedures; agents; Decarburizing; Top overhauling; Visual inspection; inspection by measurement; Engine inspection sheets: Service limits; machining of component parts : boring and honing of Engine components; camshaft grinding and lapping of engine valves; Fitting valve seat inserts and guides; Idea of oversize pistons and undersize split bearings; testing of cylinder heads and valve springs; Cooling system :maintenance and Service; troubles and diagnosis.

Books:

1. Shrivastava, Sushil Kumar., "Industrial Maintenance Management", S Chand & Company Ltd.
2. Kohli, P.L., "Automotive Chassis and Body", McGraw Hill;
3. Maruti Suzuki Manual;

BTAE 606-18 VEHICLE MAINTENANCE & DIAGNOSTICS LAB

L T P — Internal Marks: 30

- - 2 — External Marks: 20

Course Objectives:	
1	Demonstrate Fault finding, dismantling, cleaning, inspection, rectifying and reassembling of components of vehicle.

CO	Course Outcomes
CO-1	Practice Inspection, measuring and maintenance of vehicle.
CO-2	Practice dismantling & cleaning of all parts/ systems of vehicle.
CO-3	Fault diagnosis of Engine.

LIST OF EXPERIMENTS

(Students shall be required to perform any eight practical, minimum three from each section)

Section A

(Power unit including electrical)

1. Engine Reboring
2. Crank shaft grinding
3. Valve Seat grinding and Valve Lapping.
4. Silencer Decarbonizing
5. Fuel Nozzle reconditioning
6. Fuel Injection Pump Calibration.
7. Engine Ignition System of a SI system
8. Engine Starting system of a CI system

Section B

(Transmission unit & power train)

9. Demonstration of garage, garage equipment's & tools, preparation of different garage layouts
10. Demonstration of washing & greasing of vehicle
11. Engine oil change & periodic maintenance of vehicle
12. Clutch overhaul of light / heavy duty vehicle
13. Clutch overhaul of two or three-wheeler vehicle
14. Dismantling & assembly of sliding mesh gearbox
15. Dismantling & assembly of synchromesh gearbox
16. Automobile Electrical & lighting circuit

BTAE-607-18 AUTOMOTIVE TRANSMISSIONS LAB

L T P
- - 2

Internal Marks: 30
External Marks: 20

Course Objectives:	
1	Demonstrate components of transmission system, clutch, gearbox, hydrodynamic drives, automatic transmission, hydrostatic drive and electric drive-in automobiles.

CO	Course Outcomes
CO-1	Practice of assembly/disassembly of transmission system.
CO-2	Practice of Trouble shooting of transmission system of 2 wheelers and four wheelers.

List of experiments

1. Study of a layout of transmission system for a front wheel drive, rear wheel drive and a four-wheel drive arrangement.
2. Trouble shooting in different types of friction clutches.
3. Study of layout of gears and shafts in a manual type gearbox and a transaxle & their troubleshooting.
4. Study of layout in a manual & automatic gearbox for a two-wheeler & its troubleshooting.
5. Study of layout of an automatic gearbox.
6. Study of gear shifting controls in an automatic gearbox & its troubleshooting.
7. Study of a manual and electric transfer case & its troubleshooting.
8. Study of an electric drive in an Electric vehicle.

BTAE-608-18 ENGINE TESTING & POLLUTION MEASUREMENT LAB

L T P
- - 2

Internal Marks: 30
External Marks: 20

Course Objectives:	
1	To impart knowledge on performance and emission characteristics on petrol and diesel engine.

CO	Course Outcomes
CO-1	Students will be able to determine the performance characteristics of various types of engines.
CO-2	Students will be able to Conduct emission tests on various engines.

List of experiments

1. Study of Valve Timing and Port Timing Diagrams.
2. Performance test of petrol (4-stroke) engine both at full and part load.
3. Performance test of diesel (4-stroke) engine both at full and part load.
4. Study and testing on MPFI Engine and Variable compression ratio Engine.
5. Study of NDIR gas Analyser and FID.
6. Study of Chemiluminescent NOx Analyser.
7. Measurement of HC, CO, CO2, O2 using exhaust gas analyzer.
8. Diesel Engine Smoke Measurement.

Vehicle dynamics

L T P
3 1 -

Internal Marks: 40
External Marks: 60

CO No.	Course Outcomes
CO-1	Students will be able to **apply** knowledge of mathematics and engineering fundamentals to predict the dynamic response of the vehicle
CO-2	Students will be able to **identify** the problems related to vehicle handling and stability in different road conditions.
CO-3	Students will be able to **select** the effective spring rate required for the suspension system and identify the requirements of the suspension system based on applications of the vehicle.
CO-4	Students will be able to learn methods of vibration analysis for single, two and millidegree of freedom systems, and **apply** the knowledge for the vibration analysis of the vehicles and have the preparation to engage in independent learning in the context of technological change
CO-5	Students will be able to **demonstrate** knowledge and understanding the of the vehicle dynamics principles specially steering and suspension systems to apply in project work.

Introduction: Fundamental of vibration, Mechanical vibrating systems, Modeling and Simulation - Model of an automobile -Single, two and multi degrees of freedom systems – Free, forced and damped vibrations, Magnification factor -Transmissibility - Vibration absorber.

Multi Degree of Freedom Systems: Closed coupled system - Eigen valve problems - Far coupled Systems Orthogonality of mode shapes – Modal analysis - Forced vibration by matrix inversion. Approximate methods for fundamental frequency - Dunkerley's lower bound - Rayleigh's upper bound - Hozler method for close coupled and branched systems.

Suspension and Tyres: Requirements, Sprung mass frequency, Wheel hop, wheel wobble, wheel shimmy, Choice of suspension spring rate, Calculation of effective spring rate, Vehicle suspension in fore and apt directions. Ride characteristics of tyre - Effect of driving and braking torque - Gough's tyre characteristics.

Vehicle Handling: Over steer, under steer, steady state cornering, Effect of braking, driving torques on steering, Effect of camber, transient effects in cornering, Directional stability of vehicles.

Stability of Vehicles: Load distribution, Calculation of Tractive effort and reactions for different drives - Stability of a vehicle on a slope, on a curve and a banked road.

Books:

1. Gillespie.T.D., Fundamental of Vehicle Dynamics, Society of Automotive Engineers, USA;
2. Heldt.P.M., "Automotive Chassis", Chilton Co., NewYork;

3. Giles.J.G. Steering, Suspension and Tyres, llliffe Books Ltd,London
4. Giri.N.K., Automobile Mechanics, Khanna Publishers. NewDelhi
5. Rao.J.S. &Gupta.K., Theory and Practice of Mechanical Vibrations, Wiley Eastern Ltd., NewDelhi;

Automotive heating, ventilation and air conditioning

L T P
4 1 -

Internal Marks:40
ExternalMarks:60

CO No.	Course Outcomes
CO-1	Students will be **able to apply** the knowledge of mathematics and engineering fundamentals to determine the performance parameters of air conditioning systems in vehicles.
CO-2	Students will be **able to identify** and **analyse** the problems occurring in air conditioning systems and be able to troubleshoot it.
CO-3	Students will be **able to select** eco-friendly refrigerants to prevent global warming issues and contribute in societal and environmental contexts.
CO-4	Students will be **able to develop** design solutions for air conditioning and refrigeration systems by understanding the principles of psychrometry.

Air conditioning fundamentals: Fundamentals of refrigeration, basics of vehicle air conditioning system, location of air conditioning component in a car – schematic layout of a refrigeration system, component like compressor, condenser, fan blower, expansion device – expansion valve calibration, evaporator pressure regulator, lowand
high pressure switch.

Air conditioning heating system: Automotive heaters – manually controlled air conditioner – heater system –automatically control air conditioner – air conditioning protection with heater diagnosis chart.

Refrigerants: Introduction, classification, properties, selection criteria, commonly used refrigerants, eco-friendly refrigerants, global warming and ozone forming potential of refrigerants, containers, handling of refrigerants.

Psychrometry: Introduction, Psychometric properties, Inside and outside design conditions of air conditioning system. Air distribution: introduction, factors affecting design of air distribution system, types of air distribution system, air flow through the dashboard recalculating unit, duct system, ventilation, vacuum reserve.

Air conditioning maintenance and service: Cause of air conditioner failure, trouble shooting of air conditioning system, servicing heater system, removing and replacing components, leak testing, compressor service, charging and discharging, performance testing.

Books:

1. Automotive air Conditioning William H. Crouse, Tata McGraw Hill publication;
2. Automotive air Conditioning, Mitchell information service, PHI;
3. Hucho. W.H. - “Aerodynamic of Road Vehicles” – Butterworths Co.,

Measurements and Instrumentation

L T P
3 0 -

Internal Marks: 40
External Marks: 60

CO	Course Outcomes
CO-1	Students will be able to describe the basic statistical concepts and measurement standards used in industrial applications and identify the errors involved in the measurement.
CO-2	Students will be able to understand the concept of static and dynamic characteristic of a measuring instrument.
CO-3	Students will be able to explain the different types of sensors and strain gauge and circuits used in measuring system.
CO-4	Students will be able to illustrate the measurement of displacement, velocity, acceleration, force and torque with various measurement techniques and instruments.
CO-5	Students will be able to illustrate the methods of pressure, flow and temperature measurement with details of the instruments used.

Basic Statistical Concepts: Types of Measured Quantities (Discrete and Continuous), Central Tendency of Data, Mode, Median, Arithmetic Mean, Range, Deviation, Variance, Standard Deviation,

Instruments and Their Representation: Introduction, Typical Applications of Instrument Systems, Functional Elements of a Measurement System, Classification of Instruments, Standards and Calibration

Static and Dynamic Characteristics of Instruments: Range and span, accuracy and precision, calibration, hysteresis and dead zone, sensitivity and linearity, threshold and resolution; speed of response, lag, fidelity and dynamic error, dead time and dead zone. Zero, ramp and sinusoidal input signals.

Errors in Measurement: Sources of errors, systematic and random errors; statistical analysis of test-data, probable error and probability tables, ejection of test data; curve fitting, error propagation; Design and planning of experiments and report writing.

Sensors and Transducer: Introduction, Analog and Digital Transducers, Electromechanical; Potentiometric, Inductive and reluctance type, Electromagnetic, Electrodynamics, Eddy Current, Magnetostrictive, Variable Inductance, Linearly Variable Differential Transformer, Variable Capacitance, Piezo-Electric Transducer and Associated Circuits, Unbonded and Bonded Resistance Strain Gages. Strain Gage Bridge circuits, Temperature Compensation, Balancing and Calibration, Opto-Electrical Transducers, Photo Conductive Transducers, Photo Voltaic Transducers, Digital Transducers, Frequency domain transducer, Vibrating string transducer, Data, Acquisition Systems,

Data processing, Data Display and Storage, Modern Automotive Instrumentation, Study of automotive sensors and actuators.

Position, Displacement, and Velocity Measurement: Introduction, Relative motion Measuring Devices, Electromechanical, Optical, Photo Electric, Moire-Fringe, Pneumatic, Absolute Motion Devices.

Force, Acceleration and Torque Measurement: Seismic Devices, Spring Mass & Force Balance Type, Calibration, Hydraulic Load Cell, Pneumatic Load Cell, Elastic Force Devices, Separation of Force Components, Electro Mechanical Methods, Strain Gage, Torque Transducer, Toque Meter.

Pressure Measurement: Moderate Pressure Measurement, Monometers, Piezo Transducer, Dynamic Effects of Connecting Tubing, High Pressure Transducer, Low Pressure Measurement, Calibration and Testing.

Flow Measurement: Quantity Meters, Positive Displacement Meters, Flow Rate Meters, Variable Head Meters, Variable Area Meters, Rotameters, Pitot - static tube Meter, Drag Force Flow Meter, Turbine Flow Meter, Electronic Flow Meter, Electro Magnetic Flow meter. Hot-Wire Anemometer.

Temperature Measurement: Introduction, Measurement of Temperature, Non-Electrical Methods, Solid Rod Thermometer, Bimetallic Thermometer, Liquid-in -Glass thermometer, Pressure Thermometer, Electrical Methods, Electrical Resistance Thermometers, Semiconductor Resistance Sensors (Thermistors), Thermo–Electric Sensors, Thermocouple Materials, Radiation Methods (Pyrometry), Total Radiation Pyrometer, Selective Radiation Pyrometer.

Books:

1. Kumar D. S. , “Mechanical Measurements”, by, Kataria & Sons.
2. Doebelin, “Measurement systems Application and Design”, Tata McGrawHill;2002.
3. Francis S. Tse, Ivan E. Morse and Marcel Dekker, “Measurement and Instrumentation Engineering” CRC Publishers;
4. Alan S. Morris, “Principles of Measurement and Instrumentation”, Prentice Hall of India;
5. B.C. Nakra and K.K. Chaudhary, “Instrumentation, Measurement and Analysis”, Tata McGraw Hill.
6. Mechanical Measurements and Control 4th Revised & Englarged Edition;Metropolitan Book Co. Pvt. Ltd.2009

Automotive Heating, Ventilation and Air Conditioning Lab

L T P
- - 2

Internal Marks: 30
External Marks:20

CO No.	Course Outcomes
CO-1	Student will be able to understand the various components of vapour compression system
CO-2	Student will be able to calculate the COP of automobile refrigeration system.
CO-3	Student will be able understand the automobile heating system
CO-4	Student will be able to calculate the cooling and heating load for a vehicle

List of experiments

1. Study of various elements of a vapour compression refrigeration system.
2. Calculate the COP of automobile air-conditioning system.
3. Study the various components of automobile heating system.
4. Calculation/ Estimation of cooling load and heating load for a Vehicle.
5. Filling of gas inside automobile air-conditioning/refrigeration system
6. Visit to Automobile air-conditioning service station.

Measurements and Instrumentation Lab

L T P
- - 2

Internal Marks: 30
External Marks: 20

CO No.	Course Outcomes
CO-1	Students will be able to do measurement with the help of Vernier calliper, micrometre and sine bar.
CO-2	Students will be able to measure surface roughness
CO-3	Students will be able to measure speed, torque, acceleration and vibration of automobile engine.
CO-4	Students will be able to understand Calibration of a pressure gauge with the help of a dead weight gauge tester

List of experiments

1. Measurement with the help of vernier caliper and micrometer.
2. Stroboscope: measure speed of rotating elements.
3. Measurement of an angle with the help of sinebar.
4. Measurement of surface roughness.
5. Measurement of speed and torque of an engine.
6. Measurement of Acceleration and vibration of an engine
7. Calibration of a pressure gauge with the help of a dead weight gauge tester.
8. Measurement of temperature using RTD /thermocouple.
9. Determination of frequency & phase angle using C.R.O.
10. Measurement of Inductance by Maxwell's Bridge.

Computer Aided Design and Manufacturing

L T P — Internal Marks: 40
3 0 0 — External Marks: 60

After successfully completing this course the students will be able to:

CO1: Describe the function of computer systems in design and production.
CO2: Recognize geometric models, geometric modelling and practice numerous strategies
CO3: Describe Working Methodology of NC / CNC / DNC and part programming to set up FMS
CO4: Examine the combination of CAD/CAM and commercial elements in organization.

1. **Fundamentals of CAD;** Design process with and without computer; CAD/CAM system and its evaluation criteria, brief treatment of input and output devices, Display devices; Functions of a graphics package and Graphics standard GKS, IGES and STEP; Modeling and viewing; Application areas of CAD.

2. **Geometric Transformations:** Mathematics preliminaries, matrix representation of 2 and 3-dimensional transformation: Concatenation of transformation matrices. Application of geometric transformations.

3. **Geometric Modeling:** Wireframe model: solid modeling: Boundary Representation (B-rep), Constructive Solid Geometry (CSG), Parametric Modeling Technique; Mass, volumetric properties calculations; surface modeling, concepts of hidden-line removal and shading: Mechanical Assembly Kinematics analysis and simulation.
4. **Representation of curves and surfaces:** Non-parametric and parametric representation of curves. Parametric representation of Hermite Cubic, Beizer and B-spline curves; Surface and its analysis. Representation of Analytical and synthetic surfaces.

5. **Overview of FEM,** Advantages and applications, recent advance in FEM, FEA software Basic principles and general procedure of FEM.

6. **NC/CNC Machine Tools;** NC machine tools- basic components, coordinate systems; features of NC machine tools. Computerized Numerical Control (CNC): Tooling for NC machines - tool presetting equipment, flexible tooling, tool length compensation, tool path graphics; NC motion control system; Manual part programming, fixed/floating zero. Block format and codes: Computer assisted part programming. DNC and Adaptive Control: Direct numerical control: Adaptive control in machining system; Combined DNC/CNC system.

7. **Group Technology (GT):** Part families; part classification and coding system: Group technology machine cells: Advantages of GT.

8. **Computer Aided Process Planning:** Introduction and benefits of CAPP. Types of CAPP systems, machinability, data selection systems in CAPP.

9. **Computer Integrated Manufacturing Systems:** Basic Concepts of CIM: CIM Definition, The meaning of Manufacturing, Types of Manufacturing systems; Need, Elements, Evolution of CIM; Benefits of CIM; Flexible Manufacturing Systems: Physical Components of an FMS. Types of Flexibility, Layout Considerations; FMS benefits.

Books:

1. Mikell P. Groover, Emory W. Zimmers, CAD/CAM, PHI
2. D.D. Bedworth, M.R Henderson & P.M. Wolfe, Computer Integrated Design and Manufacturing, Tata McGraw Hill
3. Zeid Ibraham, CAD/CAM - theory and Practice, Tata McGraw Hill
4. P. N Rao, CAD/CAM, Tata McGraw Hill
5. C. Elanchezhian, G. Shanmuga Sundar, Computer aided manufacturing (CAM), Firewall Media

Automotive Aerodynamics

L T P
3 0 0

Internal Marks: 40
External Marks: 60

CO No.	Course Outcomes
CO-1	Understand the flow phenomenon related to vehicles and performance potential of vehicle aerodynamics.
CO-2	Illustrate the aerodynamic drag and strategies for aerodynamic development in a car.
CO-3	Interpret various shape optimizations in a car with front and rear wind shield angles.
CO-4	Calculate forces and moments on a vehicle and their effects on vehicle stability.
CO-5	Understand the principle of wind tunnels for automotive aerodynamics and various measurement techniques.

Introduction: Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and Internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics, engine cooling requirement, air flow to passenger compartment, duct for air conditioning, cooling of transverse engine and rear engine.

Aerodynamic Drag of Cars: Cars as a bluff body, flow field around car, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles.

Shape Optimization of Cars: Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners.

Vehicle Handling: The origin of forces and moments on a vehicle, lateral stability problems, methods to calculate forces and moments – vehicle dynamics under side winds, the effects of forces and moments, characteristics of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial vehicles.

Wind Tunnels For Automotive Aerodynamics: Introduction, principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods.

Books

1. Hucho. W.H. - "Aerodynamic of Road Vehicles" - Butterworths Co.,Ltd.;
2. A. Pope, "Wind Tunnel Testing" John Wiley & Sons, 2nd Edition, New York
3. Automotive Aerodynamic: Update SP-706 -SAE
4. Vehicle Aerodynamics - SP-1145 –SAE;

Hydraulic & Pneumatics System for Automobile

L T P
3 0 0

Internal Marks: 40
External Marks: 60

CO No.	Course Outcomes
CO-1	**Understand** properties of fluid and application of hydraulics and pneumatics in various fields of engineering. CH1
CO-2	**Illustrate** the design considerations and working of various elements of hydraulic system and recognize their symbols in a circuit. CH1 CH2
CO-3	**Understand** the control of hydraulic elements and demonstrate various hydraulic circuits. CH3
CO-4	**Identify** basic requirements of pneumatic systems and understand the working and selection criteria of its elements.CH4
CO-5	**Understand** the rules of the block diagram algebra in automatic control systems and mathematical conversion of its control components.CH5

SECTION-I

Introduction to Fluid Power: Application of hydraulics and pneumatics in various fields of engineering, properties of fluids, effect of temperature, Hydraulic symbols- Circuit elements, fluid pumps, motors, valves, types of control, reservoirs, advantages and disadvantages of hydraulic systems.
Elements of Hydraulic System: Pumps- Types of pumps and its selection. Hydraulic cylinders and rams- II Single acting and double acting, telescopic, seals, design considerations for pump, motor, cylinder and ram, fluid power plumbing requirements, type and purpose of strainer, filter, accumulator and its types, design considerations, reservoir, fluid temperature control, types of heat exchangers.
Control of Hydraulic Elements: Types of pressure control, Directional control valves-Two-way, four-way two position, four-way three position, manual operated, solenoid operated. Flow control valves, pressure switches, check valves, quick exhaust valve.
Hydraulic Circuits: Pressure regulating circuit, speed control circuit, accumulator circuit, booster and intensifier circuit, motion synchronizing circuit, servo circuit.

SECTION – II
Introduction to Pneumatics:
Application of pneumatics in engineering, basic requirements of pneumatic system, comparison with hydraulic system
Elements of Pneumatic System: Air compressor - Types, selection criteria, capacity control, piping layout, fittings and connectors, pneumatic control, Direction control valves, two-way, three-way, four-way check valves, flow control valves, pressure control valves, speed regulators. Quick exhaust valves, solenoid, pilot operators, Cylinders- Types and their mountings, hoses and connections, Air motors- Types, comparison with hydraulic and electric motor. Filters- Types of filters, regulators, lubricators, mufflers, dryers.
Pneumatics Circuits and Applications: Basic pneumatic circuit, impulse operation, speed control, pneumatic motor circuit, sequencing of motion time delay circuit & their applications.
Automatic Control: Need of control: Manual v/s automatic control, advantages of automatic control, open loop v/s closed loop control, generalized control system, merits, demerits and Applications, Mathematical conversion of control components: Helical spring, viscous damper and their combinations, resister, inductors, capacitor, series and parallel electrical circuits and mech. Systems, thermal and fluid systems, direct and inverse analog, grounded chair representation for material system. Block diagram algebra: Rules of block diagram algebra, reduction of block diagram, block diagram transfer function representation of speed, temperature and fluid systems, AC & DC Motors. Modes of control: On off control, proportional (P) control, integral (I) control, derivative control, P+I, P+D, P+I+D (including an analytical treatment).

Books:

1. Majumdar S.R., “Pneumatics systems-Principles and Maintenance”, Tata Mc Graw Hill Book Co., NewDelhi;
2. Majumdar S.R., “Oil Hydraulic systems-Principles and Maintenance”, Tata Mc Graw Hill Book Co., NewDelhi;
3. Pippenger J.J, “Industrial Hydraulic”, Mc-Graw Hill Book Co. Ltd., NewDelhi;
4. Pease D.A., “Basic fluid power” Prentice Hall of India, NewDelhi;
5. Stewart H.L., “Pneumatics and Hydraulics”, Taraporevala,Mumbai;
6. Esposito A., “Fluid power with application”, Prentice Hall of India, NewDelhi;
7. Yeaple, “Fluid power design handbook”, Marcel Dekkar Inc, NewYork;
8. Pneumatic handbook:R.S.Warrring;

Tractors & Farms Equipment

L T P
3 0 0

Internal Marks: 40
External Marks: 60

CO No.	Course Outcomes
CO-1	Classify various farm equipments and understand the working principles of various automotive systems.
CO-2	Illustrate various transmissions and final drive systems in tractors and earth moving machinery.
CO-3	Understand the main tractor assemblies and to illustrate various forces acting on a tractor and its weight distribution.
CO-4	Understand basic functions of plant protection & harvesting equipment's

Status of Farm Power in India, Sources of Farm Power , I.C. engines, working principles of I C engines, comparison of two stroke and four stroke cycle engines, Study of different components of I.C. engine, I.C. engine terminology and solved problems, Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication ,fuel supply and hydraulic control system of a tractor, Familiarization with Power transmission system : clutch, gear box, differential and final drive of a tractor , Tractor types, Cost analysis of tractor power and attached implement, Familiarization with Primary and Secondary Tillage implement, Implement for hill agriculture, implement for intercultural operations, Familiarization with sowing and planting equipment, calibration of a seed drill and solved examples, Familiarization with Plant Protection equipment, Familiarization with harvesting and threshing equipment.

Recommended books

1. 'Farm Machinery and Equipment', Tata McGraw Hill Publishing Co.
2. 'Farm Power and Machinery', Kitab Mahal.
3. S.C Jain and C.R. Rai, 'Tractor Engine'.

Off Road Vehicles

L T P **Internal Marks:40**
3 0 0 **External Marks:60**

Course Outcomes: At the end of the course, the students will understand the types, special features, design methodology, working principle, application of various off – road vehicles.

UNIT I INTRODUCTION AND CLASSIFICATION OF VARIOUS OFF ROAD VEHICLES

Introduction and Overview of off road vehicles; Capacity, application and requirement of off road vehicles: Earth Moving machines, Land clearing machines, scrapers and graders, Shovels, Ditchers, Tractors, Trolleys, Trailers, Platform lift truck, Fork lift trucks, Dump trucks, Truck mounted cranes, Crawler cranes, Hoisting vehicles, Multiaxle vehicles.

UNIT II TRACTORS: General description; Specifications; functions and applications; different types of tractors like light, medium and heavy-duty tractors; recent trends in tractor design; Power shift transmission and final drive in caterpillar tractor; Factors affecting efficiency of output of tractors; Troubleshooting of tractors; Merits and demerits.

UNIT III EARTH MOVING MACHINES AND FARM EQUIPMENTS: Constructional details and working features of various types of Earthmoving machines like Bulldozers, Cable and hydraulic dozers, Crawler crane, Dump trucks and dumpers, loaders-single bucket, Multi bucket and rotary types, excavators-drag and self-powered types, Cement Mixing Trucks, Water Tankers, Road Pavers, Land clearing machines, Bush cutters, rippers, Power and capacity of earth moving machines.

UNIT IV SCRAPPERS, GRADERS, SHOVELS AND DITCHERS: Constructional details and working features of Scrapers, elevating graders, Power shovel, revolving and striper shovels, drag lines, ditchers, capacity of shovels.

UNIT V MILITARY RECOVERY WHEECLES: Special features and constructional details of military recovery vehicles, tankers, gun carriers and transport vehicles.

UNIT VI ALL WHEEL DRIVE VEHICLES: Introduction and constructional details of all wheel drive vehicles.

TEXT BOOKS:

1. Georing, C.E., Stone, D.W. Smith, P,K.Turnquist “Off-Road Vehicle Engineering Principles”, ASAE2005
2. Robert L. Peurifoy, “Construction, planing, equipment and methods” Tata McGraw Hil Publishing company Ltd.
3. Nakra C.P., “Farm machines and equipments” Dhanparai Publishing company Pvt.Ltd.
4. Abrosimov K. Bran berg.A and Katayer.K., "Road making machinery", MIRPublishers.

Automotive Fuels & Emissions

LTP **Internal Marks: 40**
3 0 0 **External Marks:60**

CO No.	Course Outcomes
CO-1	**Recognize** the scenario of the conventional auto fuels and need for alternate fuels with the engine modifications required for the gaseous, bio-fuels, bio-gas, methanol, emulsified fuels. PO2 PO6 PO7
CO-2	**Recognize** the importance of future alternative fuels such as ammonia, boron and water with their features and analysis. PO7 PO8 PO12
CO-3	**Understand** the impact of different emissions on environment and **demonstrate** the formation of HC and CO in SI engines, Smoke emission in CI engines, with effects of operating variables on emission formation. PO7 PO4
CO-4	**Analyze** the exhaust gas composition before treatment and understand the NOx treatment and diesel trap oxidizers. PO7 PO6 PO4
CO-5	**Develop** control techniques for engine emission reduction. PO3 PO5 PO7 PO8

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-stoke 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, NOx 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, Chemi-liuminescent analyzer, analyzers for NOx, Gas chromatograph - Orsat apparatus -Smoke meters, spot sampling and continuous indication types like Bosch, Hart ridge.

Text Books:

1. Thipse S.S., “Alternative Fuels”, Jaico Publications.
2. Pundir B.P., “Engine Emissions: Pollutant Formation and Advances in Control Technology”, Narosa Publications.
3. Oberts E.F., “Internal Combustion Engine and Air Pollution”, Harper and Row Publisher.
4. Willard H.H., “Instrumental Method of Analysis”, CBS Publishers and Distributors.
5. Heywood.J.B., "Internal Combustion Engine Fundamentals", McGraw Hill
6. “Motor Vehicles Act / Emission Norms”, Govt of India Publications.

Computational Fluid Dynamics

L T P	**Internal Marks: 40**
3 0 0	**External Marks: 60**

Course Outcomes

After completion of this course, the students will be able to

CO1. Understand basic knowledge of computational methods in Fluid flow applications

CO2. Analyze Initial Boundary Value problems and determine various quantities of Interest.

CO3. Apply appropriate solution strategy and estimate the accuracy of the results for a given flow case CO4. Select and formulate various CFD problems by considering appropriate boundary conditions.

CO5. Adapt to various commercial software for solving numerical problems

Unit I: Introduction: Philosophy of Computational Fluid Dynamics (CFD), Impact of CFD and its use as research and design tool. Application areas: Automobile & Engine, Civil engineering, Environmental, Naval Architecture.

Unit II: Governing Equations of fluid dynamics: Derivation, discussion of their physical meaning, models of the flow, substantial derivative, Divergence of a velocity, Navier-Stokes Equation, Physical boundary conditions, Forms of governing equation suited to CFD

Unit III: Mathematical behavior of Partial Differential Equations: Classification of Quasi-Linear PDE, The Eigenvalue Method, Hyperbolic, parabolic & Elliptic equations

Unit IV: Simple CFD Techniques: The Lax-Wendroff and Mac Cormack's Technique, space marching, Relaxation Technique, aspects of numerical Dissipation and Dispersion, Artificial Viscosity, Alternating Direction-Implicit (ADI) technique. The SIMPLE Algorithm

Unit V: Application: Numerical Solution of Quasi One-dimensional Nozzle flows, two dimensional supersonic flows (Prandtl-Meyer Expansion Wave), Incompressible Couette Flow (Implicit method & the pressure correction method)

Books and References:

1. Computational Fluid Dynamics: Jr. Anderson
2. Numerical Heat Transfer and Fluid Flow: Suhas V. Patankar
3. An introduction of computation fluid dynamics: Versteeg &Malalasekera

Mechatronics System

LTP **Internal Marks: 40**
3 0 0 **External Marks: 60**

After successfully completing this course the students will be able to

CO1: Design mux, demux, flip-flops, and shift registers.
CO2: Describe the block diagram, registers, ALU, bus systems, timing & control signals, instruction cycles, andinterrupts of 8085 microprocessors.
CO3: Apply the concept of 8085 microprocessor instruction sets and addressing modes in writing assembly language program for a given problem.
CO4: Describe the interfacing of memory, 8255 PPI, ADC, DAC, 7-segment LED system, stepper motor, 8251 and8253 ICs with 8085 microprocessor

Introduction: Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface;
Sensors and transducers: classification, Development in Transducer technology, Optoelectronics-Shaft encoders, CD Sensors, Vision System, etc.;

Drives and Actuators: Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control;

Embedded Systems: Hardware Structure, Software Design and Communication, Microprocessors and microcontrollers: Microprocessor systems, Microcontrollers, Applications, programmable logic controller, Basic PLC structure, input and output units, Programmable Logic Devices, Input/output processing,Ladder programming,

Smart materials: Shape Memory Alloy, Piezoelectric and Magneto strictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.; Micro mechatronic systems: Microsensors,

Mechatronic systems: Mechatronic designs, Case studies.
Course Outcomes: Upon completion of this course, students will get an overview of mechatronics applications and the use of micro-sensors and microprocessors.

Text Books:

1) Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.)
2) Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education
3) A Textbook of Mechatronics, R.K. Rajput, S. Chand & Company Private Limited
4) Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall

Alternative Fuels and Energy Systems

LTP **Internal Marks: 40**
3 0 0 **External Marks: 60**

Course Outcomes: •1. Student will be able to understand broad comprehension of future alternative transportation fuels alcohol, biodiesel, biogas and their production technologies.
2. Student will be able to understand the use, production and performance of hydrogen as engine fuel.
3. Students will be able to understand the use, production and performance of biogas, natural gas and lpg gas
4. Student will be able to understand Electric, Hybrid fuel cell and solar vehicle technologies and their economic consideration

UNIT I Alcohols as fuels Introduction to alternative fuels. - Need for alternative fuels - Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives. Performance emission and combustion characteristics in CI and SI engines.

UNIT II Vegetable Oils as fuels various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Transesterification and emulsification of Vegetable oils - Performance in engines – Performance, Emission and Combustion Characteristics in diesel engines.

UNIT III Hydrogen as Engine Fuel Production methods of hydrogen. Combustive properties of hydrogen. Problems associated with hydrogen as fuel and solutions. Different methods of using hydrogen in SI and CI engines. Performance, emission and combustion analysis in engines. Hydrogen storage - safety aspects of hydrogen.

UNIT IV Biogas, Natural GAS and LPG as fuels Production methods of Biogas, Natural gas and LPG. Properties studies. CO2 and H2S scrubbing in Biogas., Modification required to use in SI and CI Engines- Performance and emission characteristics of Biogas, NG and LPG in SI and CI engines
.
UNIT V Electric, Hybrid and Fuel Cell Vehicles Layout of Electric vehicle and Hybrid vehicles – Advantages and drawbacks of electric and hybrid vehicles. System components, Electronic control system – Different configurations of Hybrid vehicles. Power split device. High energy and power density batteries – Basics of Fuel cell vehicles.

Text Book: 1. Ayhan Demirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer-Verlag London Limited 2008, ISBN-13: 9781846289941.

Reference Book:

1. Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.