West Bengal State Council of Technical & Vocational Education and Skill Development
(Technical Education Division)

Syllabus
of

Diploma in Automobile Engineering [AE]

Part-II (4th Semester)

Revised 2022

Semester-wise Detailed Curriculum

Semester IV (Second year)

Branch/Course: Automobile Engineering

Sl. No.	Category	Code	Course Title	Hours per week			Total contact hours/ week	Credits
				Lecture	Tutorial	Practical		
1	Program Core Course	AEPC401	Automotive Powertrain	3	0	0	3	3
2	Program Core Course	AEPC402	Fluid Mechanics & Machines	3	0	0	3	3
3	Program Core Courses	AEPC403	Automotive Component Design	2	1	0	3	3
4	Program Core Courses	AEPC404	Theory of Machines & Mechanism	3	0	0	3	3
5	Program Elective Course	AEPE411 or AEPC412	Any one Programme Elective	3	0	0	3	3
6	Program Core Course	AEPC405	Automotive Powertrain Lab	0	0	2	2	1
7	Program Core Course	AEPC406	Strength of Material and Fluid Mechanics Lab	0	0	3	3	1.5
8	Program Core Course	AEPC407	Automobile Engineering Drawing and Computer Graphics Lab	0	0	4	4	2
9	Minor Project	PR202		0	0	4	4	2
Total				**14**	**1**	**13**	**28**	**21.5**

List of Programme Electives for Fourth Semester

1. AEPE 411: Automotive Pollution & Control
2. AEPE 412: Alternate Fuels and Energy Systems

Syllabus of Automotive Powertrain

Course Code	AEPC401
	Automotive Powertrain
Number of Credits and L-T-P	3 [L – 3, T – 0, P - 0]
Course Category	PC
Prerequisites	NIL

Course Objectives:

1. To impart knowledge of various components of the Automotive powertrain.
2. To impart knowledge concerned to the power transmission phenomenon and improving the performance of vehicles.
3. To have a clear understanding of the different types of modern powertrain systems adopted in automobile vehicle.
4. To learn the different types of axle joints used in automobile vehicle.
5. To have a better understanding of final drive and its type.

Course Contents:

Module No.		Description of Topic	Contact Hrs.
1		**Automobile Clutches:** 1.1 Introduction, necessity, function and requirements of automotive Clutch. 1.2 Types of Automotive Clutch. - Friction and Non friction type Clutches. 1.3 Construction and Operation of Different type of clutches : 1.3.1 Construction and Operation of a single plate (coil and Diaphragm) dry disc clutch, multi plate, wet clutch, Centrifugal and Semi-Centrifugal Clutch. 1.3.2 Electromagnetic Clutch [Concept Only with the help of e-Sources] 1.4 Construction details of Clutch plate. Clutch lining materials, Pressure Springs, Torsional Springs. 1.5 Clutch Linkage, Clutch Adjustments. Self-Adjusting Clutch& Clutch Free Pedal Play. 1.6 Clutch operating mechanisms- Mechanical, Hydraulic &Vacuum. 1.7 Troubleshooting of all type of automotive clutch.	**08**
2	2.1	**Transmissions and Transaxles [Manual]:** 2.1.1 Purpose of the Transmission/ Transaxle - Need of Multiple Gear ratio and Multiple Torque setting. 2.1.2 Manual Transmissions and Transaxles, its' difference. 2.1.3 Function and types of [Transmission] Gear Boxes- Sliding Mesh, Constant Mesh, Synchromesh gear box -Construction, operation of each type, Power flow diagram and comparison among them. 2.1.4 Function and types of Transmission – Manual, iMT, AMT, DCT, CVT [Concept Only with the help of e-Sources] 2.1.5 Forward and Reverse Gear Ratio of different vehicles 2.1.6 Gear selector mechanism with gear lever on top of gearbox. 2.1.7 Transfer case, function, construction & power flow layout. 2.1.8 Function and types of Propulsion system – FWD, RWD, 4X4, AWD [Concept Only with the help of e-Sources]	**08**

		2.1.9 Lubrication of gear box. 2.1.10Troubleshooting of Gear box.	
	2.2	**Transmissions and Transaxles [Automatic]:** 2.2.1 Elements of Automatic Transmission. 2.2.2 Principle of Epi-cyclic Gearing and Gearing Ratio 2.2.3 Function, Construction & Working of Epicyclic Gear box. 2.2.4 Hydro-static drive and Hydro-dynamic drive 2.2.5 Fluid Coupling-Fluid-Flywheel-Torque Converter- Construction and working and application. 2.2.5 Freewheel Mechanism (Overrunning Clutch),Overdrive Mechanism. 2.2.6 Semi-Automatic Transmission, Control System. 2.2.7 Comparison with Conventional Transition System.	**08**
3		**Universal Joints and Propeller shaft:** 3.1 Necessity of Universal Joints. 3.2 Functions of universal joint and slip joint. 3.3 Types of Universal Joints, Constructional details of Universal Joint, Limitation of Universal Joint. 3.4 Necessity of CV joints. 3.5 Constant Velocity Rezappa and Tripod Joint. 3.5 Necessity of Propeller shaft. 3.6 Function and constructional features of Propeller Shaft. 3.7 Whirling of shaft, Two-piece Propeller Shaft. 3.8 Troubleshooting of different type of joints and Propeller Shaft.	**06**
4		**Final Drive and Differential:** 4.1 Necessity of Final Drive. 4.2 Types of Gears used for Final Drive & their comparison. 4.3 Final Drive Ratio & Overall Gear Ratio. Final drive ratio of different types of vehicles. 4.4 Differential - Necessity of Differential. 4.5 Construction and working of differential. 4.6 Differential lock & Differential Slip. 4.7 Function and types of Differential – Open Differential (OD), Locking Differential (LD), Limited Slip Differential (LSD), Torque Vectoring Differential (TVD)[Concept Only with the help of e-Sources] 4.7 Troubleshooting of Differential	**08**
5		**Rear Axle & Rear Axle Drive:** 5.1 Necessity of Rear Axle. 5.2 Loads acting on the rear axles. 5.3 Construction & working of different type of rear axle - Semi floating, Three quarter floating and Full floating type. 5.4 Rear Axle Drive –Types, construction and working principle of Hotchkiss Drive & Torque Tube Drive, its' use.	**04**
Total Hours			**42**

Weightage distribution in both objective, short and broad answer type questions:

Group	Module Number	Weightage (%)
A	1 & 2	40
B	3	30
C	4 & 5	30

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Analyze the principle, construction and working of elements of automotive powertrain system.
CO2	Distinguish between construction and working of various types of clutches.
CO3	Identify construction and working principle of various types of Gear Boxes.
CO4	Understand construction and principle of working of various types of Powertrain system used in modern automotive vehicle.
CO5	Analyze the working of final drive and differential action.
CO6	Understand construction and principle of working of various types of Shafts and axle.

Text Books:

1. R.B. Gupta, Automobile Engineering, Satya Prakashan, New Delhi.
2. Dr. Kirpal Singh, Automobile Engineering (Vol. – 1), Standard Publishers Distributors, New Delhi.
3. S. Srinivasan, Automotive Mechanics, Tata McGraw Hill Education, New Delhi.
4. Automotive Mechanics N.K. Giri vol-2 Khanna Publishers, New Delhi
5. S.K. Gupta, Automobile Engineering, S.Chand, New Delhi.

Reference E-links

1. Clutch - https://www.youtube.com/watch?v=devo3kdSPQY
2. Manual Transmission - https://www.youtube.com/watch?v=wCu9W9xNwtI&t=29s
3. Automatic Transmission - https://www.youtube.com/watch?v=u_y1S8C0Hmc
4. Torque converter - https://www.youtube.com/watch?v=bRcDvCj_JPs
5. Differential - https://www.youtube.com/watch?v=nC6fsNXdcMQ

Syllabus of Fluid Mechanics & Machines

Course Code	AEPC402
Course Title	Fluid Mechanics & Machines
Number of Credits and L-T-P	3 [L – 3, T – 0, P - 0]
Course Category	PC
Prerequisites	Applied Physics-I

Course Objectives:

1. To understand fluid and its properties.
2. To understand how to measure pressure, pressure difference, velocity and discharge in flow domains.
3. To understand Bernoulli's equation and its applications.
4. To understand head losses and its causes.
5. To understand working principle of centrifugal and reciprocating pumps.
6. To understand different aerodynamic effects on a vehicle.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	Fluid Properties and Measurement of Pressure: 1.1. Definition of fluid – from perspective of reaction to shear stress and lower cohesive forces. Fluid – liquid and gas. 1.2. Recap of fluid properties – Density, Specific gravity, Specific Weight, Specific Volume, Viscosity – dynamic and kinematic, Surface tension, Capillarity, Vapour Pressure, Compressibility (Definition, unit and application) 1.3. Ideal & real fluid. 1.4. Effect of temperature on Viscosity of both liquid and gas. (No explanation) 1.5. Newton's law of viscosity (Only formula and explanation, no numerical) 1.6. Capillary rise – derivation and simple numerical. 1.7. Pressure – Concept, unit, atmospheric pressure, absolute pressure, gauge pressure, vacuum pressure. 1.8. Pascal's law, derivation to show that intensity of pressure is same at a point from all direction, derivation of pressure-density-height relationship. Concept of head. Workout absolute value of atmospheric pressure. 1.9. Measurement of Pressure – Simple U-tube and differential manometer, Mechanical pressure gauge – Bourdon tube. 1.10. Simple numerical on application of simple U-tube and differential manometers where density of manometric fluid is more than working fluid.	**08**
2.	**Fluid Flow – Types, Measurements and Losses:** 2.1. Types of fluid flows - Steady & unsteady, laminar& turbulent. Reynold's number – explanation and expression. Concept of streamline. Reynold's number ranges for laminar and turbulent flows in circular pipes. 2.2. Continuity equation: - Conservation of mass, derivation, assumptions, expressions in case of compressible and incompressible fluids, discharge.	**15**

	Simple numerical with bifurcation of pipe. 2.3. Bernoulli's equation: - Conservation of energy, derivation, assumptions, application to real fluids, head loss. 2.4. Discharge – expression, unit. 2.5. Hydraulic coefficients –vena-contracta, coefficients of discharge, velocity and contraction. Relation among those. 2.6. Measurement of discharge –Venturimeter and Orificemeter, construction, derivation of discharge in venturimeter only, nozzle and diffuser effects, flow separation and formation of eddies in diverging section of venturimeter. Divergence angle. Simple numerical involving both the meters. 2.7. Measurement of velocity – Simple Pitot tube, stagnation pressure, static pressure. Simple numerical. 2.8. Head loss in pipes – Major & minor loss, sources, formula – Darcy-Weisbach (no derivation), friction coefficient, friction factor.	
3.	**Fluid Machines – Pumps:** 3.1. Pump – definition, classification – dynamic, positive displacement, rotary, reciprocating etc. 3.2. Centrifugal Pump – Construction, working principle, application, priming, types of impeller & casing, diffuser vanes. Static head, manometric head, work done, different efficiencies. Cavitation – concept &measures to prevent cavitation. Simple numerical on power required and overall efficiency. 3.3. Staging – parallel & series (concept only) 3.4. Reciprocating Pump – Construction, single acting, double acting, working principle, application; derivation of discharge & power required; slip – positive and negative, reason of negative slip, percentage of slip; Simple numerical on discharge, power required, slip etc.	**09**
4.	**Introduction to Vehicle Aerodynamics:** 4.1. Aerodynamics –Need of Vehicle Aerodynamics, objectives of vehicle aerodynamics, road resistance (total road loads), air resistance, rolling resistance. 4.2. Aerodynamic forces-Drag, types of drag, drag coefficient – effect of drag, aerodynamic aids - drag side force, lift force, effect of lift force- pitching, yawing, rolling moment 4.3. Crosswind sensitivity - recirculating flow (vortex) – diffusers - vortex noise 4.4. Wind shield – Types, application	**06**
5.	**Aerodynamic Effects on Vehicle Body:** 5.1. Aerofoil- vehicle as a bluff body - Mechanics of air flow - pressure distribution on a vehicle 5.2. Methods Used for Evaluating Vehicle Aerodynamics (Name, Definition) 5.3. Car Classifications-Different types of car body shape (name, Example)- Automobile Shapes and Aerodynamics - 5.4. Passenger Cars - Convertible (Cabriolet) and Semi-Convertible (Cabrio Coach), Coupe, Crossover (CUV), Hatchback, Landaulet (Landaulette), Limousine (Limo), Roadster, Sedan, Sport Utility Vehicle (SUV), Wagon (Station Wagon) (Definition, Example)	**04**

Total Hours	42

Weightage distribution in both objective, short and broad answer type questions:

Group	Module Number	Weightage (%)
A	1 & 2	50
B	3	20
C	4 & 5	30

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Compute capillary rise, compute pressure at a point and pressure difference between two points and compute discharge in case of bifurcation of pipes
CO2	Compute coefficient of discharge, discharge using venturimeter/orificemeter and calculate velocity using pitot tube and estimate losses in pipes.
CO3	Calculate discharge, slip and power required in reciprocating pump and power required and overall efficiency in centrifugal pumps. Identify cause of cavitation.
CO4	Identify the different aerodynamics forces on a vehicle.
CO5	Classify different shapes of automobile body.

Text Books:

1. Fluid Mechanics and Fluid Power Engineering – Dr, D. S Kumar, Kataria and Sons
2. Fluid Mechanics and Hydraulic Machines – R. K. Bansal, Laxmi Publications, New Delhi
3. Fluid Mechanics & Hydraulic Machines, S.S. Rattan, Khanna Publishing House, New Delhi
4. Hydraulic, fluid mechanics & fluid machines – Ramamrutham S, Dhanpath Rai and Sons, New Delhi.

Text Book for Unit 4 & 5:

Aerodynamics of Road vehicles, W. H. Hucho, Butterworths Co. Ltd., 1997

Reference Books:

1. Automotive Aerodynamics: Update SP-706, SAE, 1987.
2. Vehicle Aerodynamics, SP-1145, SAE, 1996.
3. Fluid Mechanics – Munson, Okiishi *et al.* –Wiely
4. Fluid Mechanics in SI units – F. M. White – McGraw Hill

Syllabus of Automotive Component Design

Course Code	AEPC403
Course Title	Automotive Component Design
Number of Credits and L-T-P	3 [L – 2, T – 1, P - 0]
Course Category	PC
Prerequisites	Engineering Mechanics, Strength of Materials

Course objectives:

After completing this course, the students will be able

1. To enable the student to design and draw simple machine components used in Automobile.
2. To understand the basic philosophy and fundamentals of Machine Design.
3. To understand the modes of failures of m/c components and decide the design criteria and equations.
4. To analyze and evaluate the loads, forces, stresses involved in components and subassemblies and decide the dimensions.
5. To develop analytical abilities to give solutions to engineering design problems.

Module No.	Description of Topic	Contact Hrs.
1	**Introduction to Design** 1.1. Introduction to design, Classification of design, Design consideration & Design procedure. 1.2. Stress analysis - Types of external loads – 1.3. Types of induced stresses - tensile – compressive – shear - Crushing and bearing pressure – bending – torsion - thermal stresses – creep- proof stresses- resilience -principal stresses. 1.4. Variable stresses in machine parts, fatigue & endurance limit, stress– Time diagrams for variable stresses - Working stresses for static load - variable or fatigue load - Stress concentration causes and remedies. 1.5. Designation of materials as per IS and introduction to International standards & advantages of standardization, use of standards in design and preferred numbers series. 1.6. Selection of material and justifications for Automobile components - Advanced Materials for automotive components. 1.7. Post design aspects - Ergonomic aspect, Aesthetic consideration (Shape, colour, surface finish) for Automobile	**08**
2	**Design of Shafts, Keys and Levers** 2.1. Conceptual understanding of shaft, axles & spindles. 2.2. Design of shaft for torsion, rigidity, bending, combined torsion & bending. [simple numerical] 2.3. Design of propeller shaft, whirling & critical speed.[No Numerical] 2.4. Rear axle – design consideration –martial [No Numerical] 2.5. Types of keys, design of Sunk Rectangular Key, Effect of keyways on strength of shaft. [simple numerical] 2.6. Types of levers – application of levers in automobile.	**08**

3	**Design of Joint** 3.1. Cotter joint- Application- Advantages- Terminology - Design consideration and Design process of Cotter joint. [simple Numerical] 3.2. Knuckle joint- Application – advantages- Terminology -Design consideration. [No Numerical]	**06**
4	**Bearing and Springs** 4.1. Bearings - location in Automobiles systems 4.2. Classification of Bearings - Sliding contact - Rolling contact – Terminology. 4.3. Life Load relationship - Basic static load rating and Basic dynamic load rating - limiting speed of ball bearing. [No Numerical] 4.4. Spring – Type of Spring – Application – Helical spring - Multi leaf spring – Terminology of spring – Spring Materials [definition only]	**05**
5	**Design of Couplings** 5.1. Coupling- Oldham coupling-Hooke's coupling (definition) 5.2. Muff Coupling- Advantages- Disadvantages – Terminology. 5.3. Clamp Coupling – Advantages – Disadvantages – Terminology. 5.4. Flange Coupling (Rigid)-Advantages – Disadvantages – Terminology - Design Procedure for Flange Coupling. [Simple Numerical]	**06**
6	**Design of IC Engine Parts** 6.1. Analyze the engine specifications and calculations of cylinder dimensions for given power. – cylinder liner- cylinder bore_ cylinder length 6.2. Design of cylinder head thickness and bolts- cylinder wall thickness. 6.3. Piston- piston material-Design of piston crown by bending strength and thermal considerations. 6.4. Design of piston rings and skirt length. 6.5. Design of piston pin for bearing - bending & shear considerations. 6.6. Simple numerical on cylinder – cylinder head – piston	**09**
Total Hours		**42**

Weightage distribution in both objective, short and broad answer type questions:

Group Name	Module Number	Weightage (%)
A	1 & 2	40
B	3 & 4	20
C	5 & 6	40

Course Outcome:

At the end of the course, the student will be able to:

CO1	Distinguish different type of force act in a loaded system.
CO2	Design shaft, key and engine component in different load condition.
CO3	Identify the different Automobile component and their application.
CO4	Able to grasp the concept of designing of different Automobile part.
CO5	Analyze various forces coming on the piston and design the process of the component.

Text Books:

1. Introduction to Machine Design – V. B. Bhandari, Tata Mc- Graw Hill, New Delhi.
2. Machine design – R. K. Jain, Khanna Publication, New Delhi.
3. Machine design – Pandya & Shah, Dhanpat Rai & Son, New Delhi.
4. A Text Book of Machine Design, Khurmi R S, Gupta J K, Eurasia Publishing house, New Delhi, 2010.

Reference Books:

1. Machine Design – Sadhu Singh, Khanna Book Publishing Co., Delhi (ISBN: 978-9382609-575)
2. Machine Design Data Book – Sadhu Singh, Revised Edition, Khanna Book Publishing Co., Delhi (ISBN: 978-9382609-513).
3. Mechanical Engineering Design – Joseph Edward Shigley, Tata Mc- Graw Hill, New Delhi.
4. Machine design – Pandya & Shah, Dhanpat Rai & Son, New Delhi.
5. Design Data Book – PSG Coimbtore, PSG Coimbtore.
6. Hand Book of Properties of Engineering Materials & Design Data for Machine Elements – Abdulla Shariff, Dhanpat Rai & Sons, New Delhi.

Syllabus of Theory of Machines & Mechanisms

Course Code	AEPC404
Course Title	Theory of Machines & Mechanisms
Credits and L-T-P	3 [L – 2, T – 1, P - 0]
Course Category	PC
Prerequisites	Engineering Mechanics

Course Objectives:

1. To impart basic knowledge of theory of machine
2. To understand construction of cam profiles for desired motion of followers
3. To understand methods of power transmission and field of applications
4. To understand construction and working of flywheel and governors
5. To understand construction and working of brakes & dynamometers.
6. To understand functions of clutches and bearings, related theories.
7. To understand the importance and methods of balancing, causes and harmful effects of vibrations.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	Basic Kinematics: 1.1 Introduction to kinematics, Machine & structure. 1.2 Rigid & Resistant body; 1.3 Kinematic link - its types, kinematic pair-its types, Kinematic chain, types of joints in a chain; 1.4 Mechanism, inversion of mechanism, four bar chain- single slider crank mechanism only. (No expression/ derivation, no numerical)	**03**
2.	**Cams and Followers:** 2.1 Concept; Definition and application of Cams and Followers; 2.2 Classification of Cams and Followers; 2.3 Follower motions and their displacement diagrams like uniform velocity, SHM, uniform acceleration and Retardation (no discussion on expressions) 2.4 Drawing of profile of radial cam with knife-edge and roller follower with and without offset with reciprocating motion (graphical method only, no numerical for calculation of velocity or acceleration/retardation).	**05**
3.	**Power Transmission:** 3.1 Types of Drives – Belt, Chain, Rope, Gear drives & their comparison; 3.2 Belt Drives - Flat belt, V– belt & its applications; Material for flat and V-belt; (Simple numerical); 3.3 Angle of lap, Belt length, Slip and Creep, Law of Belting, Determination of Velocity Ratio, Ratio of tight side and slack side tension; Centrifugal tension and Initial tension; Condition for maximum power transmission (Simple numerical); 3.4Gear Drives – Spur gear terminology; Types of gears and gear trains, their selection for different applications; Train value & Velocity ratio for simple, compound, reverted and simple epicyclic gear trains; Calculation of gear ratio,	**12**

	centre distance between two shafts, Torque & power transmission; Methods of lubrication;[simple numerical] 3.5 Chain Drives –Selection of Chain & Sprocket wheels; Methods of lubrication; Advantages & Disadvantages; [no numerical] 3.6 Rope Drives – Types, applications, advantages & limitations of Steel ropes.[no numerical]	
4.	**Flywheel and Governors:** 4.1 Flywheel - Concept, function and application of flywheel with help of turning moment diagram for single cylinder 4-Stroke I.C. Engine (simple numerical); 4.2 Coefficient of fluctuation of energy, Coefficient of fluctuation of speed and its significance; Determination of mass of flywheel and energy stored in a flywheel.(simple numerical) 4.3Governors- Types and explanation with neat sketches (Centrifugal, Watt and Porter); Concept, function and applications & Terminology of Governors; (No deduction on related expressions and no numerical) 4.3 Comparison between Flywheel and Governor.	**08**
5.	**Brakes & Dynamometers:** 5.1 Function of brakes and dynamometers; 5.2 Types of brakes and Dynamometers; Comparison between brakes and dynamometers; 5.3 Construction and working of i) shoe brake, ii) Band Brake, iii) Internal expanding shoe brake iv) Disc Brake; Concept of Self Locking & Self energizing brakes; 5.4 Numerical problems to find braking force and braking torque for shoe & band brakes; 5.5 Construction and working of i) Rope Brake Dynamometer,[no deduction only formula based numerical problem] ii) Hydraulic Dynamometer,[no numerical] iii) Eddy current Dynamometers; ,[no numerical]	**06**
6.	**Clutches & Bearings:** 6.1 Clutches- Uniform pressure and Uniform Wear theories; Function of Clutch and its application; (no derivation and simple numerical using formula) 6.2 Construction and working of i) Single plate clutch, ii) Multi-plate clutch, iii) Centrifugal Clutch iv) Cone clutch and v) Diaphragm clutch. 6.3 Bearings – i) Simple Pivot, ii) Collar Bearing, iii) Conical pivot. (descriptions only)	**04**
7.	**Balancing & Vibrations:** 7.1 Concept of balancing; 7.2 Balancing of single rotating mass; analytical method for balancing of several masses revolving in same plane; [simple numerical] 7.3 Concept and terminology used in vibrations, Causes of vibrations in machines; their harmful effects and remedies.	**04**
Total Hours		**42**

Weightage distribution in both objective, short and broad answer type questions:

Group	Module Number	Weightage (%)
A	1 & 2	25
B	3 & 4	45
C	5, 6, 7	30

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Describe working principle, classification, if any & applications of kinematic links, kinematic chains, joints& slider crank mechanism.
CO2	Explain different types of cam & follower along with to draw cam profiles for desired follower motion
CO3	Explain different type of belt and gear drive along with to solve simple numerical problems
CO4	Describe working of flywheel and governors along with calculation of flywheel mass and energy stored.
CO5	Explain the working of different types of brake and dynamometer and to be able to calculate braking force and torque.
CO6	Explain the constructional features & working principle of clutches and bearings.
CO7	Describe & calculate balancing mass required to reduce vibration & noise, along with the harmful effects of vibration and remedies.

Text Books:

1. Theory of Machines, Khurmi Gupta, Eurasia publishing House Pvt. Ltd.
2. Theory of Machines, S.S. Rattan, McGraw Hill companies

References Books:

1. Theory of Machines, P.L. Ballaney, Khanna Publication
2. Theory of Machines, Jagdishlal, Bombay metro-politan book limited
3. Theory of Machines, Ghosh – Mallik, Affiliated East west press
4. Theory of Machines, Thomas Bevan, Pearson
5. Theory of Machines, J.E. Shigley, Oxford
6. Theory of Machines, V.P.Singh, Dhanpat Rai & Co.

Syllabus of Automotive Pollution & Control

Course Code	AEPE411
Course Title	Automotive Pollution & Control
Number of Credits and L-T-P	3 [L – 3, T – 0, P - 0]
Course Category	PE
Prerequisites	Environmental Science and Engineering, Basic theory of IC Engine

Course Objectives:

1. To develop the basic knowledge of the students in automobile engines pollution formation & control techniques, Measurement techniques.
2. Know the social, cultural, global and environmental responsibilities of the professional engineer, and the principles of sustainable design and development.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	**Introduction** Vehicle population assessment in metropolitan cities and contribution to pollution, effects on human health and environment, global warming, types of emission, transient operational effects on pollution.	**04**
2.	**Pollutant Formation in SI Engines** Pollutant formation in SI Engines, mechanism of HC and CO formation in four stroke and two stroke SI engines, NO_x formation in SI engines, effects of design and operating variables on emission formation. Two stroke engine pollution.	**06**
3.	**Pollutant Formation in CI Engines** Pollutant formation in CI engines, smoke and particulate emissions in CI engines, effects of design and operating variables on CI engine emissions. NO_x formation. Noise pollution from automobiles	**06**
4.	**Control of Emissions from SI and CI Engines** Controlling of pollutant formation in engines exhaust after treatment, charcoal canister control for evaporative emission control, emissions and drivability, positive crank case ventilation system for UBHC emission reduction, exhaust gas recirculation, exhaust after treatment – DOC, DPF, SCR and LNT measurement.	**10**
5.	**Measurement Techniques, Test Procedures & Emission Standards** NDIR analyzers, FID, chemiluminescence NO_x analyzer, oxygen analyzer, smoke measurement, constant volume sampling, particulate emission measurement, orsat apparatus. (Numerical based on formula of orsat apparatus). Test Cycles for Light, Medium & Heavy duty vehicle engines, USEPA, European, Japan & India driving cycles. Emission Standards for Light and Heavy duty engines. Emission Norms: As per	**12**

	Bharat Standard up to BS – VI.	
6.	**Health Effects of Emissions from Automobiles** Emission effects on health and environment. Emission inventory, ambient air quality monitoring.	**04**
Total Hours		**42**

Weightage distribution in both objective, short and long answer type questions:

Group Name	Unit Number	Weightage (%)
A	1 & 2	30
B	3 & 4	40
C	5 & 6	30

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Describe the emission and its effect on human health and environment.
CO2	Identify the formation of pollutant in SI engine.
CO3	Identify the formation of pollutant in CI engine
CO4	Describe the Emission control techniques.
CO5	Describe the Emission measurement techniques, Emission Standards and various test procedure

Text Books:

1. Engine Emission, B.P Pundir, Narosa Publication.
2. Automotive Pollution & Control, A. K. Babu, AKB Publishers

Reference Books:

1. Internal Combustion Engines, V .Ganesan, Tata McGraw Hill.
2. Automotive Emission Control, Crouse, W.M. and. Anglin, A.L, McGraw Hill.
3. IC Engines, Dr. S. S. Thipse, Jaico publications.
4. Engine Emissions, pollutant formation, G.S .Springer and D.J. Patterson, Plenum Press.
5. ARAI vehicle emission test manual.

Syllabus of Alternate Fuels and Energy Systems

Course Code	AEPE412
Course Title	Alternate Fuels and Energy Systems
Number of Credits and L-T-P	3 [L – 3, T – 0, P - 0]
Course Category	PE
Prerequisites	Engineering Chemistry, Basic theory of IC engine

Course Objectives:

1. Differentiate the conventional fuels and Alternative fuels.
2. Understand the future fuel and energy systems for automobile applications in the context of production, storage, efficiency and emission.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction to Alternative Fuel** Introduction to alternative fuels, Need for alternative fuels, Availability of different alternative fuels for SI and CI engines, Selection criterion of fuel, Selection criteria of raw material.	**04**
2	**Alcohol** Introduction, Raw Material Selection criteria for Methanol and Ethanol, Potential of Methanol and Ethanol (Petrol Blends and Diesel Blends, Bio diesel production ingredient, Di methyl ether, Fuel cell) Production method of ethanol, Production methods of methanol, Methanol Economics, Methanol and Ethanol Safety Aspects, Properties of Methanol and Ethanol, Methanol and Ethanol Engine tests, Methanol and Ethanol Benefits, Engine Modification required for alcohol uses in SI and CI engine.	**08**
3	**Biodiesel** Introduction, Raw materials used for production of Bio Diesel, Biodiesel production methods, Bio Diesel Production Equipment, Types of Transesterification process, Bio Diesel Properties, Bio Diesel Quality Standards, Performance characteristics of biodiesel, Engine Tests for Bio Diesels, Engine Modification required for biodiesel uses in engine, Challenges for Bio Diesel.	**07**
4	**Biogas** Introduction, Biogas production method, Biogas Plants, Factors affecting biogas formation, Engine Modification required for biogas uses in SI and CI engine, Biogas purification methods, Emission Characteristics of biogas, Storage and safety aspect of Biogas.	**07**
5	**CNG & LPG and Hydrogen** Potential of LPG, LPG production, Properties of LPG, LPG Modelling studies, LPG Engine tests, LPG Material compatibility, LPG Economics, LPG Safety aspects, LPG Merits and Demerits, CNG Storage, CNG Distribution, CNG Safety, CNG Advantages, CNG challenges, Hydrogen Production, Hydrogen Storage,	**08**

	Hydrogen Properties, Hydrogen Economics, Hydrogen Safety, Hydrogen in Fuel cell, Hydrogen in SI and CI engines, Hydrogen Benefits, Hydrogen Barriers and challenges	
6	**Electric, Hybrid, Fuel cell and Solar Vehicle** Introduction, Need of Electric, Hybrid, Fuel cell and Solar vehicle, Principle of Electric Vehicles, Construction of Electric vehicles, Benefits and Challenges of Electric Vehicle, Fuel Cell Vehicles, Types of Fuel cell vehicle, Topological configuration of electric, hybrid vehicle.	**08**
Total Hours		**42**

Weightage distribution in both objective, short and long answer type questions:

Group Name	Unit Number	Weightage (%)
A	1 & 2	35
B	3 & 4	35
C	5 & 6	30

Course Outcomes:

At the end of the course, the student will be able to:

CO1	To understand broad comprehension of future alternative transportation fuels: alcohol, biodiesel, biogas and their production technologies.
CO2	To understand environmental assessment and performance assessment of alternative fuels.
CO3	To understand Electric, Hybrid fuel cell and solar vehicle technologies and their economic consideration
CO4	To apply various methods for alternative fuel usages and engine modification requirement in automobile engines.

Text Books:

1. Alternative Fuels, Dr. S. S. Thipse, Jaico publications.
2. Electric & Hybrid Vehicles, A.K. Babu, Khanna Publishing.

Reference Books:

1. Alternative Fuels for Transportation, A. S. Ramadhas, CRC Press.
2. Internal Combustion Engines, V .Ganesan, Tata McGraw Hill.
3. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, Mehrdad Ehsani, Yimin Gao, Ali Emadi, CRC Press.
4. Electric and Hybrid Vehicles, Tom Denton, Routledge.

Syllabus of Automotive Powertrain Laboratory

Course Code	AEPC405
Course Title	Automotive Powertrain Laboratory
Number of Credits and L-T-P	1 [L – 0, T – 0, P - 2]
Course Category	PC
Prerequisites	NIL

Course Objectives:

1. To prepare Vehicle Layout and Automotive Powertrain System
2. To find out the process of Clutch engaging and disengaging mechanism.
3. To identify different gear ratio of Manual transmission system.
4. To know about Automatic Transmission System
5. To distinguish between different type of joints
6. To know about the Differential

Course Contents:

Exp. No.	Description of Experiments	Contact hours
1.	Understand the layout, of "Vehicle Layout and Automotive Powertrain System laboratory", make use of various tools, and measuring devices, write their specifications, application and care to be taken while using the same.	**04**
2.	Dismantle and assemble a single plate dry type clutch assembly, to understand it's construction and working. Sketch and label all the components.	**04**
3.	Dismantle and assemble Torque Converter assembly, to understand construction and working. sketch and label all of its components.	**04**
4.	Dismantle and assemble a Synchromesh gearbox, to understand its construction and working. Observe gear shifting (synchronizing action), draw power flow diagrams, and calculate gear ratios of different gears (1st, 2nd, 3rd , 4th. 5th Gear & Reverse).	**06**
5.	Observe and draw Automatic transmission layout of a Four wheeler vehicle	**04**
6.	Dismantle and assemble a Propeller shaft, Slip joint, CV joint and Universal Joint, to understand their construction and working. Sketch the same.	**06**
7.	Dismantle and assemble the open and Limited Slip Differential, to understand its construction and working. Sketch the unit showing the exact location of the bearings. Also find the gear ratio of final drive	**04**
8.	Dismantle and assemble the front and Rear axle, to understand its construction and working and also find out the type of axle	**04**
Total Hours		**28**

Experiment Number 1, 2, 4 & 6 are compulsory and any two from the serial number 3, 5, 7 & 8.

Course Outcomes:

At the end of the course, students will be able to:

CO1	Identify basic tools of Powertrain Laboratory
CO2	Dissemble and assemble vehicle transmission system

CO3	Identify different types of gears and gear ratios
CO4	Able to grasp the construction and working procedure of Manual & Automatic transmission system
CO5	Identify the construction and working of Differential

Text Books:

1. R.B. Gupta, Automobile Engineering, Satya Prakashan, New Delhi.
2. Dr. Kirpal Singh, Automobile Engineering (Vol. – 1), Standard Publishers Distributors, New Delhi.
3. S. Srinivasan, Automotive Mechanics, Tata McGraw Hill Education, New Delhi.
4. Automotive Mechanics N.K. Giri vol-2 Khanna Publishers, New Delhi
5. S.K. Gupta, Automobile Engineering, S.Chand, New Delhi.

Syllabus of Strength of Materials & Fluid Mechanics Laboratory

Course Code	AEPC406
Course Title	Strength of Materials & Fluid Mechanics Laboratory
Number of Credits and L-T-P	1.5 [L – 0, T – 0, P - 3]
Course Category	PC
Prerequisites	Strength of Materials, Fluid Mechanics & Machines

Course Objectives:

1. To experimentally find out hardness and toughness of metallic objects.
2. To find out various points of interest from stress-strain diagram of a mild steel specimen.
3. To experimentally find out shear modulus of metallic objects.
4. To experimentally verify Bernoulli's equation.
5. To experimentally find out discharge coefficient of venturimeter/ orificemeter.
6. To identify main components of centrifugal pump.

Course Contents:

Module No.	Description of Experiments	To be Done	Number of hours
1.	**Experiments from Strength of Materials:** 1.1. Experimental determination of hardness of a metallic specimen using either Rockwell/ Brinell hardness test. 1.2. Experimental determination of impact strength (toughness) of a metallic specimen using either Charpy/ Izod impact test. 1.3. Tensile test of a mild steel specimen using UTM and draw corresponding stress-train diagram and identify yield stress, ultimate stress, breaking stress, percentage elongation in length (measure of ductility) and determination of modulus of elasticity. 1.4. Conduct torsion test on a mild steel bar and find the value of shear modulus G. 1.5. Find strength and stiffness of a spring.	**At least three**	**16**
2.	**Experiments from Fluid Mechanics & Machinery:** 2.1. Study of Bourdon tube pressure gauge. 2.2. Experimental determination of coefficient of discharge of venturimeter/ orificemeter. 2.3. Experimental verification of Bernoulli's theorem. 2.4. Dismantling and assembly of a centrifugal pump and identify its main components. 2.5. Trial on a centrifugal pump to determine efficiency.	**At least three**	**26**
Total Hours		**42**	

Course Outcomes:

At the end of the course, students will be able to:

CO1	Calculate hardness, toughness and shear modulus of metallic samples.
CO2	Calculate elastic modulus, ultimate strength and measure ductility of metallic samples.

CO3	Calculate coefficient of discharge of venturi/orifice meter.
CO4	Identify different components of a centrifugal pump.
CO5	Verify experimentally the Bernoulli's equation.

Text Books:

1. Fluid Mechanics and Machinery Laboratory Manual, N. Kumara Swamy, Charotar Publishing House Pvt. Ltd., ANAND 388 001, Ed. 2008
2. Strength of Materials – S.S Bhavikatti, Vikas Publishers
3. Strength of Materials – U.C. Jindal, Pearson
4. Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi
5. A Text Book Strength of Material– R.K. Bansal, Laxmi Publication New Delhi

Syllabus of Automobile Engineering Drawing and Computer Graphics Laboratory

Course Code	AEPC407
Course Title	Automobile Engineering Drawing and Computer Graphics Laboratory
Number of Credits and L-T-P	2 [L – 0, T – 0, P - 4]
Course Category	PC
Prerequisites	Engineering Drawing, Strength of Material, Automotive Component Design

Course Objectives:

1. To prepare drawing sheet with proper dimension and title box on CAD
2. To find out the process of design on CAD.
3. To identify different commend and tools and there use on CAD.
4. To know about designing process of flange coupling.
5. To distinguish between CAD drawing and hand drawing.

Course Contents:

Exp. No.	Description of Experiments	To be Done	Number of hours
1.	Introduction of CAD and brief description about basic commend, tools, absolute coordinate system and relative coordinate system.	**Compulsory**	**6**
2.	Line, poly line, rectangle, arc line, different type of line, circle, Move ,Rotate, Scale, copy, Mirror, erase, trim, extend, Annotate Dimension Style on CAD		**4**
3.	Single line text, Multiline text, Layer properties, Insert blocks, Dimensional Manage, Drawing units, Sheet settings on CAD		**6**
4.	Isometric views - Isometric top, left, right and Isometric diagrams on CAD.		**4**
5.	Calculate the dimension of a shaft for given problem (problem given by the faculty) and design it in a drawing sheet and on CAD.	**At least three**	**12**
6.	Calculate the dimension of Flange Coupling for given problem (problem given by the faculty) and design it in a drawing sheet and on CAD.		**12**
7.	Calculate the dimension of Flange Cotter joint for given problem (problem given by the faculty) and design it in a drawing sheet and on CAD.		**12**
8.	Calculate the dimension of Engine block (cylinder, piston) joint for given problem (problem given by the faculty) and design it in a drawing sheet and on CAD.		**12**
Total Hours		**56**	

Course Outcomes:

At the end of the course, students will be able to:

CO1	Identify basic tools of CAD
CO2	Draw isometric view of an object on CAD

CO3	Arrange for proper dimension and text in a CAD drawing.
CO4	Draw the dimension of a joint (Cotter/ Flange Coupling).
CO5	Identify different tolerances and consideration for design

Text Books:

1. Engineering Drawing with Auto CAD – B. V. R Gupta & M. Raja Roy, I K International Publication House
2. AutoCAD 2019 Training Guide - Linkan Sagar & Nisha Gupta, BPB; First, 2019 edition
3. A Hand Book on AutoCAD Tools Practice - Azhar Wahab, Notion Press; 1st edition
4. Learn AutoCAD in a Easy Way, Sunil K. Pandey, S.K. Kataria& Sons; Reprint 2010 edition
5. Engineering Drawing + Autocad, K. Venugopal, New Age; Fifth edition
6. Introduction to Machine Design – V. B. Bhandari, Tata Mc- Graw Hill, New Delhi.
7. Machine design – R. K. Jain, Khanna Publication, New Delhi.
8. Auto design problems, K M Aggarwal, Satyaprakashan

Syllabus of Minor Project

Course Code	PR202
Course Title	Minor Project
Number of Credits and L-T-P	2 [L – 0, T – 0, P - 4]
Course Category	Minor Project
Prerequisites	All subject up-to 4th Semester

Course objectives:

After completing this course, the students will be able

1. To understand the solution process of real life problem
2. To achieve the potentiality of doing team work
3. To understand the gap between academic knowledge and actual real life problem solving knowledge.
4. To prepare the project repot in a skill full way.

Project group:

- Formation of project group: Maximum 8 to 12 students per batch.
- Each project group should select work by consulting the guide.

Course Content:

During this minor project, two projects have to be completed by each group.
One project is on an advanced topic of Automotive Engine or Automotive Transmission

Some suggested topics are:

- Design considerations of Combustion Chamber in CI engine and parameters to control abnormal combustion.
- Solar powered vehicle
- Conversion of petrol vehicle into LPG vehicle by using LPG kit
- Electromagnetic clutch
- Dual Clutch Transmission (DCT)
- Preparation of Bio-Diesel.
- Ethanol Blended Petrol and its effect on SI engine
- Torque Vectoring Differential
- Automatic tyre pressure inflation system
- Smart antitheft system for vehicle security

and

One project is about any subject within the 1st to 4th semester syllabus.

Some Suggested Topics are:

- Forming Aerodynamics profile for any type of passenger car.
- Propeller shaft designing for front wheel, rear wheel and all-wheel drive in CAD.

- Advanced surface coating techniques like chemical vapor deposition, ion implantation, and physical vapor deposition.
- Engine Performance and testing
- Hybrid Car
- Electric car
- Fuel cell Electric Vehicle (FCEV)
- Electronic Stability Program (ESP)
- Different Vehicle testing processes
- Maintenance of Automobile air-conditioning systems.

Faculty Members can select any project topic from out of the suggested topic but within the syllabus.

After completion of the project, each students group should prepare two (one for each project) comprehensive report to indicate what are observed and learnt during the project work. The student may contact guide for assigning topics and problems and should prepare the final report on the assigned topics. The project report should be signed by the guide and HOD.

The format of the project report will be as following

Sl. No.	Particulates
1	Title page
2	Deceleration page
3	Acknowledgement
4	Certificate from guide
5	Abstract
6	Objective
7	Literature review/ background survey/history
8	Present work
9	Methodology
10	Observation
11	Conclusion
12	References

Internal Assessment:

1. Project Report: The project Report will be evaluated on the basis of following criteria (as applicable) 40 Marks

Sl. No.	Criteria for evaluation of Internship Report
1	Originality
2	Adequacy and purposeful write up
3	Organizations, format, drawing, sketches, style, language
4	Practical applications and relationships with basic theory
5	Concept taught in the outcome

2. Attendance and work process 20 Marks

External Assessment:

Seminars must be arranged for the student based on the project report, in presence of project guide, Internal Committee constituted by the concerned department of the Institute and External examiner/s. The evaluation will be based on the following criteria. 40 Marks

Sl. No.	Criteria for evaluation of Internship Report
1	Quality of content presented
2	Proper Planning for presentation
3	Effectiveness of presentation
4	Depth of knowledge and skills
5	Viva voce

Course Outcome:

At the end of the course, the student will be able to:

CO1	learn new skills and supplement knowledge
CO2	Learn & practice communication and teamwork skills.
CO3	Learn strategies like time management, multi-tasking, real time technical knowledge etc.
CO4	Can apply their knowledge for doing some application oriented work.
CO5	Gain practical experience in a real working environment.