DR. A. P. J. ABDUL KALAM TECHNICAL UNIVERSITY

LUCKNOW, UTTAR PRADESH

STUDY & EVALUATION SCHEME WITH SYLLABUS

FOR

B. TECH. 3rd YEAR

Automobile Engineering

[Effective from Session: 2020-21]

Syllabus Content of B. Tech Automobile Engineering

S. No.	Code	Departmental Component	Subject Name	L T P	Credits	Page No.
1	**Third Year Evaluation Scheme (V & VI Semester)**					
2	KME 501	Core	Heat and Mass Transfer	3 1 0	4	
3	KME 502	Core	Strength of Material	3 1 0	4	
4	KAU 501	Core	Automotive Transmission	3 1 0	4	
5	KME 551	Lab	Heat Transfer LAB	0 0 2	1	
6	KME 553	Lab	IOT Lab	0 0 2	1	
7	KAU 551	Lab	Automotive Engines, fuels & lubricants lab	0 0 2	1	
8	KME 054	Elective	I C Engine, fuels & lubricants	3 0 0	3	
9	KAU 051	Elective	Automobile Engines & Combustion	3 0 0	3	
10	KAU 052	Elective	Automotive chassis and suspension	3 0 0	3	
11	KME 052	Elective	Mechatronics Systems	3 0 0	3	
16	KAU 601	Core	Automotive Air Conditioning	3 1 0	4	
17	KME 602	Core	Machine Design	3 1 0	4	
18	KME 603	Core	Theory of Machine	3 1 0	4	
19	KAU 651	Lab	Automotive Pollution and Control Lab	0 0 2	1	
20	KME 652	Lab	Machine Design Lab	0 0 2	1	
21	KME 653	Lab	Theory of Machine Lab	0 0 2	1	
22	KAU 061	Elective	Automotive Electrical and Electronics	3 0 0	3	
23	KAU 062	Elective	Vehicle Transport Management	3 0 0	3	
26	**Fourth Year Evaluation Scheme (VII & VIII Semester)**					
27	KAU 071	Elective	Automotive Pollution and Control	3 0 0	3	
28	KAU 072	Elective	Hybrid Vehicle Propulsion	3 0 0	3	
29	KAU 073	Elective	Vehicle Body Engineering & safety	3 0 0	3	
30	KAU 074	Elective	Trouble Shooting, Service & Maintenance Repair	3 0 0	3	

B. Tech Automobile Engineering
Evaluation Scheme

SEMESTER- V													
Sl. No.	Code	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KME 501	Heat and Mass Transfer	3	1	0	30	20	50		100		150	4
2	KME 502	Strength of Material	3	1	0	30	20	50		100		150	4
3	KAU 501	Automotive Transmission	3	1	0	30	20	50		100		150	4
4		Departmental Elective-I	3	0	0	30	20	50		100		150	3
5		Departmental Elective-II	3	0	0	30	20	50		100		150	3
6	KME 551	Heat Transfer LAB	0	0	2				25		25	50	1
7	KME 553	Internet of Things Lab	0	0	2				25		25	50	1
8	KAU 551	Automotive Engines, fuels & lubricants lab	0	0	2				25		25	50	1
9	KAU 552	Mini Project or Internship Assessment*	0	0	2				50			50	1
10	NC+	Constitution of India / Essence of Indian Traditional Knowledge	2	0	0	15	10	25		50			
11	MOOCs (Essential for Hons. Degree)												
	Total		**17**	**3**	**6**							**950**	**22**

***The Mini Project or internship (4 - 5 weeks) conducted during summer break after IV semester and will be assessed during V semester.

SEMESTER- VI													
Sl. No.	Code	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KAU 601	Automotive Air Conditioning	3	1	0	30	20	50		100		150	4
2	KME 602	Machine Design	3	1	0	30	20	50		100		150	4
3	KME 603	Theory of Machine	3	1	0	30	20	50		100		150	4
4		Departmental Elective-III	3	0	0	30	20	50		100		150	3
5		Open Elective-I	3	0	0	30	20	50		100		150	3
8	KAU 651	Automotive Pollution and Control Lab	0	0	2				25		25	50	1
6	KME 652	Machine Design Lab	0	0	2				25		25	50	1
7	KME 653	Theory of Machine Lab	0	0	2				25		25	50	1
9	NC +	Essence of Indian Traditional Knowledge/ Constitution of India	2	0	0	15	10	25		50			
10	MOOCs (Essential for Hons. Degree)												
		Total	**17**	**3**	**6**							**900**	**21**

Automobile Engineering Departmental Electives

Students can choose any elective horizontally from the pool of electives.

Departmental Elective-I	KME 054	I C Engine, fuels & lubrication	KAU 051	Automobile Engines & Combustion
Departmental Elective-II	KAU 052	Automotive chassis and suspension	KME 052	Mechatronics Systems
Departmental Elective-III	KAU 061	Automotive Electrical and Electronics	KAU 062	Vehicle Transport Management
Departmental Elective-IV	KAU 071	Automotive Pollution and Control	KAU 072	Hybrid Vehicle Propulsion
Departmental Elective-V	KAU 073	Vehicle Body Engineering & safety	KAU 074	Trouble Shooting, Service & Maintenance Repair

Suggested MOOCs

It is suggested that the students may also do the following MOOCs in addition to mandatory courses. This will enhance their learning. One MOOC per semester is recommended.

Sem V	**Vehicle Dynamics** https://nptel.ac.in/courses/107/106/107106080/	**Advance Machining Process** https://swayam.gov.in/nd1_noc20_me76/preview	**Control Systems** https://swayam.gov.in/nd1_noc20_ee90/preview
Sem VI	**Control Systems** https://swayam.gov.in/nd1_noc20_ee90/preview	**Material Characterization** https://swayam.gov.in/nd1_noc20_mm14/preview	**Introduction to robotics** https://swayam.gov.in/nd1_noc20_de11/preview
Sem VII	**Introduction to hybrid and Electric Vehicles** MOOC: https://nptel.ac.in/courses/108/103/108103009/	**Automation in Manufacturing** https://swayam.gov.in/nd1_noc20_me58/preview	**Introduction to Industry 4.0 and Industrial Internet of Things** https://swayam.gov.in/nd1_noc20_cs69/preview
Sem VIII	**Fuel Cell Technology** https://nptel.ac.in/courses/103/102/103102015/	**Production and Operation Management** https://swayam.gov.in/nd1_noc20_mg06/preview	**Supply Chain management** MOOC: https://swayam.gov.in/nd2_cec20_mg11/preview

Subject Code: KME 501	Heat and Mass Transfer	L T P : 3 1 0	Credits: 4

The students will be able to		Blooms Taxonomy
CO-1	Understand the fundamentals of heat and mass transfer.	K2
CO-2	Apply the concept of steady and transient heat conduction.	K3
CO-3	Apply the concept of thermal behavior of fins.	K3
CO-4	Apply the concept of forced and free convection.	K3
CO-5	Apply the concept of radiation for black and non-black bodies.	K3
CO-6	Conduct thermal analysis of heat exchangers.	K4

UNIT-1

Introduction to Heat Transfer (L-5 Hours)

Introduction of thermodynamics and Heat Transfer, Modes of Heat Transfer: Conduction, convection and radiation, Effect of temperature on thermal conductivity of different types of materials, Introduction to combined heat transfer mechanism, General differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems, Initial and system boundary conditions.

Steady State one-dimensional Heat conduction (L-3 Hours)

Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation, Concept of thermal resistance, Analogy between heat and electricity flow, Thermal contact resistance and over-all heat transfer coefficient, Critical radius of insulation for cylindrical, and spherical bodies.

UNIT-2

Fins (L-3 Hours)

Heat transfer through extended surfaces and its classification, Fins of uniform cross-sectional area, Error in measurement of temperature of thermometer wells.

Transient Conduction (L-3 Hours)

Transient heat conduction, Lumped capacitance method, Time constant, Unsteady state heat conduction in one dimension only, Heisler charts and their applications.

UNIT-3

Forced Convection (L-5 Hours)

Basic concepts: Hydrodynamic boundary layer, Thermal boundary layer, Approximate integral boundary layer analysis, Analogy between momentum and heat transfer in turbulent flow over a flat surface, Mixed boundary layer, Flow over a flat plate, Flow across a single cylinder and a sphere, Flow inside ducts, Thermal entrance region, Empirical heat transfer relations, Relation between fluid friction and heat transfer, Liquid metal heat transfer.

Natural Convection (L-5 Hours)

Physical mechanism of natural convection, Buoyant force, Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates, cylinders and sphere, combined free and forced convection, Effect of turbulence.

UNIT-4

Thermal Radiation (L-8 Hours)

Basic concepts of radiation, Radiation properties of surfaces, Black body radiation Planck's law, Wein's displacement law, Stefan-Boltzmann law, Kirchhoff's law, Gray body, Shape factor, Black-body radiation, Radiation exchange between diffuse non-black bodies in an enclosure, Radiation shields, Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Greenhouse effect, Radiation network analysis.

UNIT-5

Heat Exchanger (L-5 Hours)

Different types of heat exchangers, Fouling factors, Overall heat transfer coefficient, Logarithmic mean temperature difference (LMTD) method, Effectiveness-number of transfer unit (NTU) method and Compact Heat Exchangers.

Condensation and Boiling (L-3 Hours)

Introduction of condensation phenomena, Heat transfer relations for laminar film condensation on vertical surfaces and on outside& inside of a horizontal tube, Effect of non-condensable gases, Drop wise condensation, Heat pipes, Boiling modes, pool boiling, Hysteresis in boiling curve, Forced convection boiling.

Introduction to Mass Transfer (L-2 Hours)

Introduction of Fick's law of diffusion, Steady state equimolar counter diffusion, Steady state diffusion through a stagnant gas film, Heat and Mass Transfer Analogy -Convective Mass Transfer Correlations

Reference Books:-

1. Fundamentals of Heat and Mass Transfer, by Incroperra & DeWitt, John Wiley and Sons
2. Heat and Mass Transfer by Cengel, McGraw-Hill
3. Heat Transfer by J.P. Holman, McGraw-Hill
4. Heat and Mass Transfer by Rudramoorthy and Mayilsamy, Pearson Education
5. Heat Transfer by Ghoshdastidar, Oxford University Press
6. A text book on Heat Transfer, by Sukhatme, University Press.
7. Heat Transfer by Venkateshan, Ane Books Pvt Ltd
8. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill
9. Heat and Mass Transfer by R Yadav, Central Publishing House.

Subject Code: KME 502	Strength of Material	L T P : 3 1 0	Credits: 4

Course Outcomes: The student will be able to		Blooms Taxonomy
CO 1	Understand the concept of stress and strain under different conditions of loading	K2
CO 2	Determine the principal stresses and strains in structural members	K3
CO 3	Determine the stresses and strains in the members subjected to axial, bending and torsional loads	K3
CO 4	Apply the concepts of stresses and strain in solving problems related to springs, column and pressure vessels	K3
CO 5	Calculate the slope, deflection and buckling of loaded members	K3
CO 6	Analyze the stresses developed in straight and curved beams of different cross sections	K4

Unit I **8 Hours**

Compound stress and strains: Introduction, normal stress and strain, shear stress and strain, stresses on inclines sections, strain energy, impact loads and stresses, state of plane stress, principal stress and strain, maximum shear stress, Mohr's circle for plane stress, three dimensional states of stress & strain, equilibrium equations, generalized Hook's law, theories of failure. Thermal Stresses.

Unit II **8 Hours**

Stresses in Beams: Pure Bending**,** normal stresses in beams, shear stresses in beams due to transverse and axial loads, composite beams.

Deflection of Beams: Differential equation of the elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams

Torsion: Torsion, combined bending & torsion of solid & hollow shafts, torsion of thin walled tubes.

Unit III **8 Hours**

Helical and Leaf Springs: Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs.

Columns and Struts: Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and middle quarter rules, struts with different end conditions, Euler's theory for pin ended columns, effect of end conditions on column buckling, Ranking Gordon formulae, examples of columns in mechanical equipment and machines.

Unit IV **8 Hours**

Thin cylinders & spheres: Introduction, difference between thin walled and thick walled pressure vessels, thin walled spheres and cylinders, hoop and axial stresses and strain, volumetric strain.

Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders, stresses in rotating shaft and cylinders, stresses due to interference fits.

Unit V **8 Hours**

Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression.

Unsymmetrical Bending: Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section.

Text Books:

1. Strength of materials by Sadhu Singh, Khanna Book Publishing Co. (P) Ltd.
2. Strength of Material by Rattan, MC GRAW HILL INDIA
3. Mechanics of Materials by B.C. Punmia, Laxmi Publications (P) Ltd.

Reference Books:

1. Mechanics of Materials by Hibbeler, Pearson.
2. Mechanics of material by Gere, Cengage Learning
3. Mechanics of Materials by Beer, Jhonston, DEwolf and Mazurek, MC GRAW HILL INDIA
4. Strength of Materials by Pytel and Singer, Harper Collins
5. Strength of Materials by Ryder, Macmillan.
6. Strength of Materials by Timoshenko and Yσungs, East West Press.
7. Introduction to Solid Mechanics by Shames, Pearson
8. Mechanics of material by Pytel, Cengage Learning
9. An Introduction to Mechanics of Solids by Crandall, MC GRAW HILL INDIA
10. Strength of Materials by Jindal, Pearson Education
11. Strength of Materials by Basavajaiah and Mahadevappa, University Press.

Subject Code: KAU 501	Automotive Transmission	L T P : 3 1 0	Credits: 3

Course Outcomes: The students will be able to		Blooms Taxonomy
CO-1	Understand the Gearbox construction based on mechanism of working	K2
CO-2	Understand the constructional, working principle of various types clutches	K2
CO-3	Understand the components and working of fluid coupling and Hydrodynamic drive.	K2
CO-4	Understand Principal construction and working of Hydrostatic and Electric drive	K2
CO-5	Understand Components and types of Automatic Transmissions & its drives.	K2
CO-6	Apply the design concepts of gear box and clutches for calculating gear ratio and forces & wear of clutches.	K3

Unit 1: Clutch

Principle of operation, Requirements of Clutch, Constructional details Different types of clutches- Single plate coil spring and Diaphragm spring clutches, and multi-plate clutch, Centrifugal and Automatic Clutch, Dry and Wet type of clutch, Friction lining materials, Factors influencing clutch wear & points of wear, Clutch Design, Clutch faults- Diagnosis & Remedies.

Unit 2: Gear Box

Need for Transmission system, Forces acting on vehicle, Tractive Effort, Gear box Objective of the Gear Box, Determination of gear ratios for vehicles, Power-Torque Characteristics, Performance characteristics in different speeds, Different types of gear boxes – sliding, constant and synchromesh type, Planetary gear box, 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, Gear box maintenance

Unit 3: Hydrodynamic drive

Fluid Coupling & One way clutches: Fluid coupling-Principle-Constructional details. Torque capacity. Performance characteristics. Reduction of drag torque in fluid coupling. Fluid requirements and characteristics

One way clutches (Over running clutch) Constructional details of various types, percentage slip, like sprag clutch, ball and roller one way clutches, necessity and field of application, working

Hydrodynamic Torque converters: Introduction to torque converters, Principle constructional details, performance characteristics. Comparisons characteristics, Multistage torque converters and Polyphase torque converters.

Unit 4: Hydrostatic and Electric Drives

Hydrostatic drive – principle, types, advantages, limitations - Comparison of hydrostatic drive with hydrodynamic drive - Construction and working of typical Janny hydrostatic drive.

Electrical drives: advantages and limitations, principles of Ward Leonard system of control Modern electric drive for buses and performance characteristics.

Unit 5: Automatic transmission:

Automatic transmissions relative merits and demerits when compared to conventional transmission, Components of Automatic Transmission, Types of Automatic transmission - Automated manual transmission (AMT), Automatic step transmission (AT), Dual-clutch transmission (DCT), Continuously variable transmission (CVT)

Epicyclic Gear Box- Principle of Planetary gear trains. Introduction to epicyclic gear train – external mesh and internal mesh planetary geartrains, The fundamentals of a hydraulic control system, basic four speed hydraulic control system.

Books and References:

1. Heldt, P.M., "Torque converters", Chilton Book Co., 1962.
2. Newton and Steeds, "Motor vehicles", Illiffe Publishers, 1985.
3. Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.
4. Hydrostatic transmissions for vehicle applications, I Mech E Conference, 1981-88.
5. Crouse,W.H., Anglin,D.L.," Automotive Transmission and Power Trains construction", McGraw Hill, 1976.
6. Heinz Heisler, "Advance vehicle Technology", Butterworth-Heinemann, 2002.

Subject Code: KME 551	Heat and Mass Transfer Lab	L T P : 0 0 2	Credits: 1

The students will be able to		Blooms Taxonomy
CO1	Apply the concept of conductive heat transfer.	K3
CO2	Apply empirical correlations for both forced and free convection to determine the value of convection heat transfer coefficient	K3
CO3	Apply the concept of radiation heat transfer for black and grey body.	K3
CO4	Analyze the thermal behaviour of parallel or counter flow heat exchangers	K4
CO5	Conduct thermal analysis of a heat pipe	K4

List of Experiments

Minimum eight experiment of the following

1. To determine thermal conductivity of conductive material(s).
2. To determine thermal conductivity of insulating material(s).
3. To determine heat conduction through lagged pipe.
4. To determine heat transfer through fin under natural convection.
5. To determine the heat transfer Rate and Temperature Distribution for a Pin Fin.
6. Determination of thermal conductivity of different types of fluids.
7. Experiment on Stefan's Law - determination of emissivity, etc.
8. Experiment on convective heat transfer through flat plate solar collector.
9. To compare LMTD and Effectiveness of Parallel and Counter Flow Heat Exchangers.
10. To find the heat transfer coefficient for Forced Convection in a tube.
11. To find the heat transfer coefficient for Free Convection in a tube.
12. To conduct experiments on heat pipe.
13. To study the rates of heat transfer for different materials and geometries.
14. Visit to a Thermal Power Station for practical exposure.

Subject Code: KME 553	Internet of Things Lab	L T P : 0 0 2	Credits: 1

The students will be able to		Blooms Taxonomy
CO1	Understand Internet of Things and its hardware and software components	K2
CO2	Interface I/O devices, sensors & communication modules	K3
CO3	Remotely monitor data and control devices	K3
CO4	Design prototype of IoT based smart system	K4
CO5	Develop IoT based projects for real life problem	K6

List of Experiments:

S.No.	Name of Experiment	Outcome
1	Familiarization with concept of IoT, Arduino/Raspberry Pi and perform necessary software installation.	Will be able to understand IoT, Arduino/Raspberry Pi, and also able to install software setup of Arduino/ Respberry Pi
2	To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON/OFF motor.	Able to use relay to control motor and other mechanical devices
3	To interface sensors* with Arduino/Raspberry Pi and write a program to displaysensors data on the computer screen.	Able to retrieve data from sensors and to display it on computer screen
4	To interface OLED with Arduino/Raspberry Pi and write a program to display sensor data on it.	Able to retrieve data from sensors and to display it on OLED
5	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/OFF Relay when sensor data is detected.	Able to control relay with help of microcontroller and sensors
6	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/OFF Solenoid valve when sensor data is detected.	Able to control Solenoid valve with help of microcontroller and sensors
7	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/OFF Linear Actuator when sensor data is detected.	Able to control linear actuator with help of microcontroller and sensors
8	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/OFF Starter Motor when sensor data is detected.	Able to control Starter Motor with help of microcontroller and sensors
9	To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smart phone using Bluetooth.	Able to communicate sensor data from microcontroller to smart phone
10	To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn Actuators* ON/OFF when message is received from smart phone using Bluetooth.	Able to control actuators using mobile phone through Bluetoth
11	Write a program on Arduino/Raspberry Pi to upload Sensor data to thingspeak cloud.	Able to upload status of devices and sensors on web cloud

12	Write a program on Arduino/Raspberry Pi to retrieve sensors data from thingspeak cloud.	Able to retrieve status of devices and sensors from web cloud
13	Develop IoT based smart lock system for Motor cycle/Car	Able to develop smart lock system of motor cycle/car
14	Develop IoT based Smart water flow system	Able to develop smart water flow system
15.	Develop IoT based home security system	Able to develop smart home security system

Components required-

1. Arduino with cable
2. Raspberry Pi with cable and memory card
3. Node MCU
4. *Sensors-IR, LDR, DHT11 sensor, Push button, Pressure senser, Temperature sensor, Vibration, Rotation, Location, Torque, Sound, Weight etc.
5. *Actuators-LED, Buzzer, Relay Switch, Motors, Motor Drivers, OLED, Display, Linear Actuator, Solenoid Valve, Starter Motor etc.
6. Bluetooth Module, Wi-fi Module, Ethernet Module
7. Smart Phone
8. Computer
9. Power Supply-5V, 12V, 3.3V
10. Internet facility

Subject Code: KAU 551	Automobile Engines Fuel and Lubricant Lab	L T P : 0 0 2	Credits:1

Course Outcomes: Student will be able to		Blooms Taxonomy
CO1	Demonstrate the various components of multi-cylinder SI and CI engines	K3
CO2	Demonstrate the various types of fuel injection systems in SI and CI engines	K3
CO3	Calculate the various performance characteristics of CI and SI engines.	K3
CO4	Calculate temperature dependence viscosity and viscosity index of lubricating oil by viscometer.	K3
CO5	Calculate the different properties for various fuels and lubricants.	K3
CO6	Demonstrate the use of different types of lubricants in various automotive components.	K3

LIST OF EXPERIMENTS

(Minimum eight/Ten Experiments are required to be conducted)

1. Dismantling and study of Multi-cylinder Petrol/Diesel Engine
2. Assembling of Multi-cylinder Petrol/Diesel Engines.
3. Study of Petrol/Diesel engine fuel system
4. Performance of CI and SI engine
5. Temperature dependence of viscosity of lubrication oil by Redwood Viscometer.
6. Viscosity Index of lubricating oil by Saybott Viscometer.
7. Flash and Fire points of Diesel, K-Oil, Bio-Diesel.
8. Flash and Fire points of lubricants.
9. Drop point of grease and mechanical penetration in grease.
10. Calorific value of liquid fuel.
11. Calorific value of gaseous fuel
12. Study of semi-solid lubrication in various Automobile Unit & Joints
13. Study of lubrication in transmission, final drive, steering gearbox.
14. Study of analytical equipment for oil analysis.

    To find out volatility characteristic of different fuels by ASTM distillation methods (diesel, gasoline lubricants).

Semester – V: Departmental Elective – I: Specialization – Thermal Engineering

Subject Code: KME 054	I C Engine, Fuels & Lubrication	L T P : 3 0 0	Credits: 3

CO	Course Outcome	Bloom Taxonomy
CO 1	Explain the working principle, performance parameters and testing of IC Engine.	K 2
CO 2	Understand the combustion phenomena in SI and CI engines and factors influencing combustion chamber design.	K 2
CO 3	Understand the essential systems of IC engine and latest trends and developments in IC Engines.	K 2
CO 4	Understand the effect of engine emissions on environment and human health and methods of reducing it.	K 2
CO 5	Apply the concepts of thermodynamics to air standard cycle in IC Engines	K 3
CO 6	Analyze the effect of various operating parameters on IC engine performance.	K 4

Unit-I **(9 Hours)**

Introduction to I.C Engines: Engine classification and basic terminology, Two and four stroke engines, SI and CI engines, Valve timing diagram, Valve mechanism- Push rod type, Overhead type (SOHC,DOHC).
Thermodynamic analysis of Air standard cycles: Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles Fuel air cycle, factors affecting the fuel air cycle, Actual cycle.
Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines.

Unit–II **(7 Hours)**

Combustion: Stages of Combustion in SI & CI engine, Factors affecting combustion, Flame speed, Ignition Delay, Abnormal combustion and its control.
Combustion chamber: Squish, Swirl & tumble, Combustion chamber design for SI & CI engine & factors affecting it.

Unit–III **(8 Hours)**

Carburetion, Mixture requirements, Carburetors and fuel injection system in SI Engine, MPFI, Scavenging in 2 Stroke engines.

Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings.

Turbocharging & its types- Variable Geometry Turbocharger, Waste Gate Turbocharger, Effect of turbocharging on power & emission.

Unit-IV **(9 Hours)**

Engine Emission and Control: Pollutant - Sources and types – Effect on environment and human health - formation of NOx - Hydrocarbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions - Methods of controlling Emissions - Catalytic converters and Particulate Traps - Selective Catalytic Reduction(SCR) - Diesel Oxidation Catalyst (DOC).

Fuels: Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines.

UNIT-V **(9 Hours)**

Engine Cooling and Lubrication: Different cooling systems, Radiators and cooling fans, Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation.

Ignition System in SI Engine: Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition.

Recent trends in IC engine: Lean burn engine, Stratified charge spark ignition engine, Homogeneous charge spark ignition engine, GDI.

Text Books

1. A Course in International Combustion Engines, by Mathur & Sharma, Dhanpat Rai & Sons.
2. I.C Engine, by Ganeshan, Tata McGraw Hill Publishers.

Reference Books

1. I.C Engine Analysis & Practice by E.F Obert.
2. Internal Combustion Engine Fundamentals, by John B. Heywood, Tata Mcgraw Hill Publishers.
3. Engine Emission, by B. B. Pundir, Narosa Publication.
4. Engineering Fundamentals of Internal Combustion Engines by W.W. Pulkrabek, Pearson Education.
5. Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford & IBH Publishing CO.
6. Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India.

Semester – V: Departmental Elective – I: Specialization – Automobile Engineering

Subject Code: KAU 051	Automobile Engines & Combustion	L T P : 3 0 0	Credits: 3

CO	Course Outcome	Bloom Taxonomy
CO 1	Explain the working principle, performance parameters and testing of IC Engine.	K 2
CO 2	Understand the phenomena of combustion and its application in SI and CI engines.	K 2
CO 3	Understand the essential systems of IC engine.	K 2
CO 4	Understand the effect of engine emissions on environment and human health and methods of reducing it.	K 2
CO 5	Apply the concepts of thermodynamics to air standard cycle in IC Engines	K 3
CO 6	Analyze the effect of various operating parameters on IC engine performance.	K 4

Unit-I (8 Hours)

Introduction to I.C Engines: Engine classification and basic terminology, Two and four stroke engines, SI and CI engines, Valve timing diagram, Valve mechanism- Push rod type, Overhead type (SOHC,DOHC).

Thermodynamic analysis of Air standard cycles: Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles Fuel air cycle, factors affecting the fuel air cycle, Actual cycle.

Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines.

Unit–II (8 Hours)

Combustion and Flames Propagation:

Chemical composition– Flue gas analysis, Dew point of products, Stoichiometry, Stoichiometry relations, theoretical air required for complete combustion, Enthalpy of formation, Heating value of fuel, Adiabatic flame Temperature, Chemical equilibrium.

Flame stability, Burning velocity of fuels, Measurement of burning velocity, Factors affecting the burning velocity, Flame Propagation, Flame Temperature– Theoretical, Adiabatic & Actual, Ignition Limits, Limits of Inflammability.

Unit–III (7 Hours)

Combustion: Stages of Combustion in SI & CI engine, Factors affecting combustion, Flame speed, Ignition Delay, Abnormal combustion and its control.

Combustion chamber: Squish, Swirl & tumble, Combustion chamber design for SI & CI engine & factors affecting it.

Ignition System in SI Engine: Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition.

Unit-IV (9 Hours)

Carburetion, Mixture requirements, Carburetors and fuel injection system in SI Engine, MPFI, Scavenging in 2 Stroke engines.

Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings.

Turbocharging & its types- Variable Geometry Turbocharger, Waste Gate Turbocharger, Effect of turbocharging on power & emission.

UNIT-V **(8 Hours)**

Engine Emission and Control: Pollutant - Sources and types – Effect on environment and human health - formation of NOx - Hydrocarbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions - Methods of controlling Emissions - Catalytic converters and Particulate Traps - Selective Catalytic Reduction(SCR) - Diesel Oxidation Catalyst (DOC).

Fuels & Lubricants: Fuels for SI and CI engine, Rating of SI engine and CI engine fuels, Gaseous fuels, LPG, CNG, Biogas, Different cooling systems, Type of lubrication, Lubrication oils, Crankcase ventilation.

Text Books

3. A Course in International Combustion Engines, by Mathur & Sharma, Dhanpat Rai & Sons.
4. Fuels and combustion, Sharma and Chander Mohan, Tata McGraw Hill
5. I.C Engine, by Ganeshan, Tata McGraw Hill Publishers.

Reference Books

7. I.C Engine Analysis & Practice by E.F Obert.
8. Internal Combustion Engine Fundamentals, by John B. Heywood, Tata Mcgraw Hill Publishers.
9. Engine Emission, by B. B. Pundir, Narosa Publication.
10. Engineering Fundamentals of Internal Combustion Engines by W.W. Pulkrabek, Pearson Education.
11. Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford & IBH Publishing CO.
12. Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India.

Semester – V: Departmental Elective – II: Specialization – Automobile Engineering

Subject Code: KAU 052	Automotive chassis and suspension	L T P : 3 0 0	Credits: 3

Course Outcomes: The students will be able to		Blooms Taxonomy
CO-1	Understand different types of automotive chassis and frames used in automobiles.	K2
CO-2	Understand transmission and drive line components used in automobile.	K2
CO-3	Understand the axles and types of steering system in automobile.	K2
CO-4	Understand the constructional features of barking, suspension system, wheels and tyres in automobile application.	K2
CO-5	Understand the recent advancements made in chassis components of automobile.	K2
CO-6	Apply the concepts of braking and steering system to design the same for automobile application.	K3

Unit I

Chassis Layouts and Frames

Definition of Chassis, Types of Chassis Layout with reference to Power Plant Location and Drive

Automotive Frames - Material Selection and its Constructional Details, Various types, Different Loads acting on Frame, Testing of Automotive Frames.

Unit II

Transmission: Clutches- Requirements and its types, Gear Box: Need and requirements, Types of manual gear boxes, Gear ratio Calculation.

Drive Line: Propeller Shaft - Design Considerations & Constructional Details, Universal Joints, Constant Velocity Joints, Hotchkiss Drive, Torque Tube Drive, Radius Rods and Stabilizers, Final drive - Different types, Multi-axle Vehicles, Differential - Working Principle and Constructional Details, Non–Slip Differential, Differential Locks.

Unit III

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

Braking Systems: Stopping Distance, Braking Efficiency, Weight Transfer during Braking, Drum Brakes - Constructional Details, Leading and Trailing Shoe, Braking Torque, Disc Brake - Types and Constructional Details, Hydraulic Braking System, Pneumatic Braking System, Power–Assisted Braking System, Factors affecting brake performance, operating temperature, Area of brake lining, clearance.

Unit IV

Axles: Live and Dead Axles, Constructional Details, Different Types of Loads acting on Drive Axles, Rear Axle Shaft Supporting Types: Semi Floating, Full Floating, Three Quarter Floating, Axle Housings and Types

Steering System: Types of Front Axles and Stub Axles, Front Wheel Geometry, Condition for True Rolling Motion of Wheels during Steering, Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over Steer and Under Steer, Reversible and Irreversible Steering, Hydraulic Power Assisted Steering, Turning Radius Calculation.

Unit V

Wheels and Tyres: Types of Wheels, Construction, Structure and Function, Forces acting on wheels, Wheel Dimensions, Wheel Balancing, and Wheel Alignment. Structure and Function of Tyres, Static and Dynamic Properties of Pneumatic Tyres, Types of Tyres, Materials, Tyre Section & Designation, Factors affecting Tyre Life, Tyre Rotation.

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

Recent Trends in Chassis Systems: Special Steering Columns, 4 wheel steering system, Electric Power Steering, Anti–Lock Braking System, Traction Control Systems, Electronic Brake force Distribution Systems, Corner Stability Control, Hill Assist, and Autonomous Braking System.

Text Books:

1. Automobile engineering", Dr. Kripal Singh.
2. Automobile engineering" R.B. Gupta, Satya Prakashan.

References:

1. Heldt P.M., "Automotive chassis", Chilton Co., New York.
2. Giles J.G., "Steering, Suspension and tyres", Iliffe Book Co., London.
3. A.K. Babu, Automotive Mechanics, Khanna Publishing House

Semester – V: Departmental Elective – II: Specialization – Automation and Industry 4.0

Subject Code: KME 052	Mechatronics Systems	L T P : 3 0 0	Credits: 3

Course Outcome: Student will be able to		Bloom Taxonomy
CO 1	Identify key elements of mechatronics and its representation by block diagram.	K 2
CO 2	Understand the concept of sensors and use of interfacing systems.	K 2
CO 3	Understand the concept and applications of different actuators	K 2
CO 4	Illustrate various applications of mechatronic systems.	K 2
CO 5	Develop PLC ladder programming and implementation in real life problem.	K 5

Unit I: Mechatronics & Its Scope

Mechatronics System: Introduction to Mechatronic Systems, Evolution, Scope, Application Areas, Basic Elements and Control of Mechatronics systems, Advantages and disadvantages of Mechatronics, Industrial applications of Mechatronics, autotronics, bionics, and avionics and their applications

Control System Concepts: Introduction to Control Systems, Elements of control system, Basic of open and closed loop control with example.

Unit II: Sensor & Transducer

Definition and classification of sensor and transducer, performance terminology, static and dynamic characteristics, Principle of working and application of Inductive Proximity, Capacitive Proximity, Photoelectric, Ultrasonic, Magnetic, Hall Effect, Tactile Sensor, load cell, LVDT and interfacing sensors in Mechatronic system.

UNIT III: ACTUATION SYSTEMS

Fluid Based Actuation: Concept of Hydraulic and Pneumatic Actuation system, Oil and Air preparation unit, Direction Control Valve, Pressure Control Valve, Single and doubly actuated systems, Actuators and Accumulators.

Electrical Actuation Systems: Introduction to Switching devices,Concept of Electro Mechanical Actuation, Solenoids and Solenoid Operated Direction Control Valves, Principle of working of DC and 3 Phase Induction Motor, Stepper motors and Servo Motors with their merits and demerits.

UNIT IV: INDUSTRIAL CONTROLLERS

Programmable Logic Controllers: Basic Structure, Types and Working Principle, Concept of Scan Cycle and Scan Time, IO's and its Types, Selection Criteria and Applications

Programming Techniques: Ladder diagram –Concept of Contacts and Coil, Latching/ Holding Circuit, Memory Bits, Timers and Counter.

UNIT V: MECHATRONICS APPLICATIONS:

Control of conveyor motor, sorting and packaging unit, pick and place robot, coin counter, operations of bottling plant, domestic washing machine, use of PLC for extending and retracting pneumatic pistons and their different combinations, automatic car park system, engine management system, other applications in manufacturing.

Text Books:

1. Rolf Isennann, " Mechatronics Systems", Springer, 2005.
2. W. Bolten, "Mechatronics", Pearson Education 2003.
3. HMT Ltd, "Mechatronics:, Tata McGraw Hill 1998.
4. K. P. Ramachandran, G.K. Vijayaraghavan, M.S. Balasundaram, Mechatronics - Integrated Mechanical Electronic Systems, Wiley.

Subject Code: KAU 601	Automotive Air Conditioning	L T P : 3 1 0	Credits: 4

Course Outcomes: The students will be able to		Blooms Taxonomy
CO-1	Understand the working of Air conditioning system and its components	K2
CO-2	Understand the working of Automotive heater & cooling system and its components	K2
CO-3	Understand the working of various types of refrigerants, their properties and their handling.	K2
CO-4	Understand various types of controls used in automotive air conditioning	K2
CO-5	Understand the maintenance and service procedure of Air conditioner	K2
CO-6	Apply the basic concepts to calculate the COP and other performance parameters for different RAC systems	K3

UNIT-I:

Automotive air conditioning fundamentals:

Purposes of Heating, Ventilation and Air Conditioning- Environmental Concerns- Ozone layer depletion- Location of air conditioning components in a car. Schematic layout of a vehicle air conditioning system, refrigeration system. Psychometry – Basic terminology and Psychrometric mixtures- Psychrometric Chart- Related problems.

UNIT-II:

Automotive cooling and heating system:

Fixed thermostatic and Orifice tube system- Variable displacement thermostatic and Orifice tube system- Vehicle air conditioning operation.

Types of compressor- Compressor Clutches- Compressor Clutch electrical circuit- Compressor lubrication- Condensers- Evaporators- Expansion devices- Evaporator temperature and pressure controls- receiver-drier- Accumulators- refrigerant hoses, Connections and other assemblies- Heating system.

UNIT-III:

Air-conditioning controls, delivery system and refrigerants:

Types of Control devices- Preventing Compressor damage- Preventing damage to other systems.

Maintaining drivability- Preventing Overheating Ram air ventilation- Air delivery Components- Control devices- Vacuum Controls Containers.

Handling refrigerants – Discharging, Charging & Leak detection – Refrigeration system diagnosis– Diagnostic procedure – Ambient conditions affecting system pressures.

UNIT-IV:

Automatic temperature control:

Different types of sensors and actuators used in automatic temperature control- Fixed and variable displacement temperature control.Semi-Automatic- Controller design for Fixed and variable displacement type air conditioning system.

UNIT-V:

System servicing and testing:

Special tools for servicing vehicle air conditioning – Diagnosing components and air conditioning systems.Diagnosing cooling system- Air delivery system- Automatic temperature Control system diagnosis and service.

Books and References:

1. Warren Farnell and James D.Halderman, "Automotive Heating, Ventilation, and AirConditioning systems", Shop Manual, Pearson Prentice Hall, 2004.
2. William H Crouse and Donald L Anglin, "Automotive Air conditioning", McGraw Hill Inc.,1990.
3. Mitchell Information Services, Inc., "Mitchell Automatic Heating and Air Conditioning Systems", Prentice Hall Inc., 1989.
4. Paul Weisler, "Automotive Air Conditioning", Reston Publishing Co. Inc., 1990.
5. Mc Donald K.L., "Automotive Air Conditioning", Theodore Audel series, 1978.
6. Goings,L.F., "Automotive Air Conditioning", American Technical services, 1974.

Subject Code: KME 602	Machine Design	L T P : 3 1 0	Credits: 4

Course Outcomes: The student will be able to		Blooms Taxonomy
CO 1	Recall the basic concepts of Solid Mechanics to understand the subject.	K2
CO 2	Classify various machine elements based on their functions and applications.	K2
CO 3	Apply the principles of solid mechanics to machine elements subjected to static and fluctuating loads.	K3
CO 4	Analyze forces, bending moments, twisting moments and failure causes in various machine elements to be designed.	K4
CO 5	Design the machine elements to meet the required specification.	K5

Unit I **8 Hours**

Introduction

Definition, Design requirements of machine elements, Design procedure, Standards in design, Standards designation of carbon & alloy steels, Selection of preferred sizes, Selection of materials for static and fatigue loads, Design against Static Load

Design against Fluctuating Loads

Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Design for finite & infinite life, Soderberg, Goodman, Gerber criteria

Unit II **8 Hours**

Riveted Joints

Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint

Welded Joints

Stress relieving of welded joints, Butt Joints, Fillet Joints, Strength of Butt Welds, Strength of parallel fillet welds, Strength of transverse fillet welds

Shafts

Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity, Keys, Types of keys, Selection of square and flat keys, Strength of sunk key

Unit III **8 Hours**

Spur Gears

Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards.

Helical Gears

Terminology, Proportions for helical gears, Force components on a tooth of helical gear, Virtual number of teeth, Beam strength and wear strength of helical gears, Dynamic load on helical gears, Design of helical gears.

Introduction, Classification and Applications of Bevel & Worm Gears

Unit IV **8 Hours**

Sliding Contact Bearing

Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing.

Rolling Contact Bearing

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

Unit V **8 Hours**

IC Engine Parts

Selection of type of IC engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin;

Friction Clutches

Clutches, Difference between coupling and clutch, Single plate friction clutch, Torque transmitting capacity, Multi-Disk Clutches, Friction Material

Note: Design data book is allowed in the examination

Text Books:

1. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.
2. Design of Machine Elements, Sharma and Purohit, PHI.

Reference Books:

1. Mechanical Engineering Design, 9e – Joseph E. Shigely, McGraw Hill Education.
2. Machine Design-Maleev and Hartman, CBS Publishers.
3. Design of Machine Design-M.F. Spott, Pearson Education.
4. Elements of Machine Component Design, Juvinal & Marshek, John Wiley & Sons.
5. Machine design, Robert L. Norton, Pearson Education
6. Theory & Problem of Machine Design (Schaum's Outline Series) Hall, Holowenko, Laughlin, Tata McGraw Hill Co.
7. Machine Design-Sharma and Agrawal, S.K. Kataria & Sons.
8. Machine Design, U C Jindal, Pearson Education.

Subject Code: KME 603	Theory of Machines	L T P : 3 1 0	Credits: 4

Course Outcomes: The students will be able to		Blooms Taxonomy
CO1	Understand the principles of kinematics and dynamics of machines.	K2
CO2	Calculate the velocity and acceleration for 4-bar and slider crank mechanism	**K3**
CO3	Develop cam profile for followers executing various types of motions	K3
CO4	Apply the concept of gear, gear train and flywheel for power transmission	K3
CO5	Apply dynamic force analysis for slider crank mechanism and balance rotating & reciprocating masses in machines.	K3
CO6	Apply the concepts of gyroscope, governors in fluctuation of load and brake & dynamometer in power transmission	K3

Unit I **(09 Hours)**

Introduction, mechanisms and machines, kinematics and kinetics, types of links, kinematic pairs and their classification, types of constraint, degrees of freedom of planar mechanism, Grubler's equation, mechanisms, inversion of four bar chain, slider crank chain and double slider crank chain.

Velocity analysis: Introduction, velocity of point in mechanism, relative velocity method, velocities in four bar mechanism, instantaneous center.

Acceleration analysis: Introduction, acceleration of a point on a link, acceleration diagram, Corioli's component of acceleration, crank and slotted lever mechanism,.

Unit II **(10 Hours)**

Cams: Introduction, classification of cams and followers, cam profiles for knife edge, roller and flat faced followers for uniform velocity, uniform acceleration

Gears and gear trains: Introduction, classification of gears, law of gearing, tooth forms and their comparisons, systems of gear teeth, length of path of contact, contact ratio, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, sun and planet gear train.

Unit III **(08 Hours)**

Force analysis: Static force analysis of mechanisms, D'Alembert's Principle, dynamics of rigid link in plane motion, dynamic force analysis of planar mechanisms, piston force and crank effort. Turning moment on crankshaft due to force on piston, Turning moment diagrams for single cylinder double acting steam engine, four stroke IC engine and multi-cylinder engines, Fluctuation of speed, Flywheel.

Unit IV **(09 Hours)**

Balancing: Introduction, static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of reciprocating masses, balancing of single cylinder engine.

Governors: Introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors. Effort and Power of governor.

Unit V **(09 Hours)**

Brakes and dynamometers: Introduction, Law of friction and types of lubrication, types of brakes, effect of braking on rear and front wheels of a four wheeler, dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer

Gyroscope: Space motion of rigid bodies, angular momentum, gyroscopic couples, gyroscopic stabilization, ship stabilization, stability of four wheel and two wheel vehicles moving on curved paths.

Text / Reference Books

1. Kinematics and dynamics of machinery: Wilson and Sadler, Third edition, Pearson.
2. Theory of Mechanisms and Machines: Amitabh Ghosh and Ashok Kumar Mallik, Third Edition Affiliated East-West Press.
3. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Oxford University Press
4. Kinematics and dynamics of machinery: R L Norton, McGraw Hill
5. Theory of Machines: S.S. Rattan, McGraw Hill
6. Theory of Machines: Thomas Bevan, CBS Publishers.

Suggested Software

MechAnalyzer

Subject Code: KAU 651	Automotive Pollution and Control Lab	L T P : 0 0 2	Credits: 1

Course Outcomes: The students will be able to		Blooms Taxonomy
CO-1	Understand the performance of petrol and diesel engines in full load and part load conditions.	K2
CO-2	Demonstrate various tests on petrol and diesel engines for calculating different operational parameters.	K3
CO-3	Study different equipments used for determining various pollutants from IC engines.	K3
CO-4	Demonstrate measurement of various pollutants emitted from IC engines by using Gas Analyzer and smoke meter.	K3

List of Experiments

1. Performance study of petrol and diesel engines both at full load and part load conditions.
2. Morse test on petrol and diesel engines.
3. Determination of compression ratio, volumetric efficiency and optimum cooling water flow rate in engines.
4. Heat balance test on an automotive engine.
5. Testing of 2 and 4 wheelers using chassis dynamometers.
6. Study of NDIR Gas Analyzer for CO and CO_2.
7. Study of Flame Ionization Detector HC.
8. Study of Chemiluminescent NOx analyzer.
9. Measurement of HC using exhaust gas analyzer.
10. Measurement of CO using exhaust gas analyzer.
11. Measurement of CO_2, using exhaust gas analyzer.
12. Measurement of O_2 using exhaust gas analyzer.
13. Diesel smoke measurement using smoke meter.

Subject Code: KME 652	Machine Design Lab	L T P : 0 0 2	Credits: 1

Course Outcomes: The student will be able to		Blooms Taxonomy
CO-1	Apply the principles of solid mechanics to design various machine Elements subjected to static and fluctuating loads.	**K3**
CO-2	Write computer programs and validate it for the design of different machine elements	**K4**
CO-3	Evaluate designed machine elements to check their safety.	**K5**

A Design of Machine Elements

1. Design a knuckle joint subjected to given tensile load.
2. Design a riveted joint subjected to given eccentric load.
3. Design of shaft subjected to combined constant twisting and bending loads
4. Design a transverse fillet welded joint subjected to given tensile load.
5. Design & select suitable Rolling Contact Bearing for a shaft with given specifications
6. Design a cylinder head of an IC Engine with prescribed parameters.
7. Design of Piston & its parts of an IC Engine

B. Computer Programs for conventional design

Computer and Language: Students are required to learn the basics of computer language such as C/C++/MATLAB so that they should be able to write the computer program.

1. Design a pair of Spur Gear with given specifications to determine its various dimensions using Computer Program in C/C++.
2. Design a pair of Helical Gear with given specifications to determine its various dimensions using Computer Program in C/C++.
3. Design of Sliding Contact Bearing with given specifications & determine its various parameters using Computer Program in C/C++.

Subject Code: KME 653	Theory of Machines Lab	L T P : 0 0 2	Credits: 1

The students will be able to:		Blooms Taxonomy
CO1	Demonstrate various mechanisms, their inversions and brake and clutches in automobiles	K2
CO2	Apply cam-follower mechanism to get desired motion of follower.	K3
CO3	Apply the concepts of gears and gear train to get desired velocity ratio for power transmission.	K3
CO4	Apply the concept of governors to control the fuel supply in engine.	K3
CO5	Determine the balancing load in static and dynamic balancing problem	K3

List of Experiments

(Minimum eight experiments out of the following)

NOTE: Student has to write computer program in C / C++ / Python and to run to compute the output values for at least ONE experiments.

1. To study various types of kinematics links, pairs, chains & Mechanisms
2. To study Whitworth Quick Return Motion Mechanisms, Reciprocating Engine Mechanism, and Oscillating Engine Mechanism
3. To study of inversions of four bar linkage
4. To study of inversions of single/double slider crank mechanisms
5. To study various types of gear (Helical, cross helical, worm, bevel gear) and gear profile (involute and cycloidal) and condition for interference Helical, cross helical, worm, bevel gear
6. To compute the output velocity invarious gear trains
7. To study gyroscopic effects through models
8. To determine gyroscopic couple on Motorized Gyroscope
9. To perform experiment on dead weight type governor to prepare performance characteristic Curves, and to find stability & sensitivity
10. To perform experiment on spring controlled governor to prepare performance characteristic Curves, and to find stability & sensitivity
11. To determine whirling speed of shaft theoretically and experimentally
12. To perform the experiment for static / dynamic balancing
13. To perform experiment on brake
14. To perform experiment on clutch
15. To perform the experiment for static / dynamic balancing.
16. To perform experiment on longitudinal vibration
17. To perform experiment on transverse vibration

Semester – VI: Departmental Elective – III: Specialization – Automobile Engineering

Subject Code: KAU 061	Automotive Electrical and Electronics	L T P : 3 0 0	Credits: 3

The students will be able to		Blooms Taxonomy
CO-1	Understand the basic concepts of electrical systems used in automobile.	K2
CO-2	Understand the constructional features of charge storage devices and methods to test these devices for their healthy operation.	K2
CO-3	Understand the principles and characteristics of charging and starting system of automobile and study the various faults occurring in system.	K2
CO-4	Understand the ignition and auxiliary system- types & constructional features used in automobile.	K2
CO-5	Describe the principles and architecture of electronics systems and its components present in an automobile related to data transfer, instrumentation, control, and security systems.	K2
CO-6	Understand latest trends developed in electrical and electronic systems of automobile and their advantages over conventional technologies.	K2

Unit 1 **[L 8 Hours]**

Introduction to electrical fundamentals – Ohm's Law, Kirchhoff's Law, Capacitance and Inductance, Simple Electric Circuits, Automotive Wiring Harnesses, Insulated and Earth Return System, Positive and Negative Earth Systems, Connectors and its types

Charge storing devices- Principle and construction of Lead Acid Battery, Nickel – Cadmium Battery, Nickel Metal, Hybrid Battery, Sodium Sulphur Battery and Aluminum Air Battery-Choice of Batteries for automotive applications, Characteristics of Battery, Battery Rating, Capacity and Efficiency, Various Tests on Battery, Battery– Charging Techniques. Maintenance of batteries.

Unit 2 **[L 8 Hours]**

Starter Systems- Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids.
Charging system components, Generators and Alternators, types, construction and Characteristics,

Charging System- Voltage and Current Regulation, Cut –out relays and regulators, Charging circuits for D.C. Generator, A.C. Single Phase and Three – Phase Alternator

Unit 3 **[L 8 Hours]**

Automotive Ignition Systems: Spark Plugs, Constructional details and Types, Battery Coil and Magneto– Ignition System Circuit details and Components, Centrifugal and Vacuum Advance Mechanisms, Non– Contact– type Ignition Triggering devices, Capacitive Discharge Ignition, Distributor–less Ignition Systems

Auxiliary Systems: Head Lamp and Indicator Lamp construction and working details, Focusing of head lamps, Anti– Dazzling and Dipper Details, Automotive Wiring Circuits. Indicators and meters, speedometers, electric horn, windshield wiper, electric horn and relay devices.

Unit 4 **[L 8 Hours]**

Automotive Electronics: Automotive networking, Bus system, Advantages of bus systems, requirements of buses, Buses in motor vehicle: CAN, FlexRay, LIN, Ethernet, IP, PSI5, MOST bus and optical fibers/wave guides, Architectures of electronic system.

Control Units: ECM, ABS control unit, Steering Control Unit, SRS control unit, Automatic Air Conditioning Control Unit.

Unit 5 **[L 8 Hours]**

Automotive Sensors and Actuators: Basic principle, Main requirements, Micromechanics, Position sensors, Speed and RPM sensors, Acceleration and vibration sensors, Pressure sensors, Flow meters, Gas sensors, concentration sensors, temperature sensors, Force sensors, Optoelectronics sensors, Sensors for driver assistance systems: Ultrasonic technology, Radar technology, LIDAR sensors Purge Control, Idling Setting Control, Immobilizer System, Stepper motors.

Books:

1. Automotive Electricals by PL Kohli, McGraw Hill Publications.
2. Robert Bosch “Automotive Hand Book”, SAE (8th Edition), 2011.

References:

1. Tom Denton, “Automobile Electrical and Electronic Systems” 4th edition- Routledge - 2012.

Barry Hollembeak, “Automotive Electricity and Electronics”, Delmar Cengage Learning; 5th edition, 2011

subject Code: KAU 062	Vehicle Transport Management	L T P : 3 0 0	Credits: 3

The students will be able to		Blooms Taxonomy
CO-1	Understand the principles of transport management for improving vehicle and operator performance.	K2
CO-2	Understand the importance of maintenance for increasing efficiency of fleet.	K2
CO-3	Understand budget formulation and supply chain management in vehicle transport.	K2
CO-4	Understand the methods of fare calculation and running cost estimation of vehicle.	K2
CO-5	Understand and comply with vehicular Regulations (i.e. Motor vehicle act) to reduce vehicular accidents & crimes.	K2

UNIT I: Organization and Management [L 9 Hours]

Forms of Ownership – principle of Transport Management – Staff administration – Recruitment and training –welfare – health and safety. Basic principles of supervising. Organizing time and people. Driver and mechanic hiring - Driver checklist - Lists for driver and mechanic – Trip leasing - Vehicle operation and types of operations.

UNIT II: Vehicle Maintenance [L 8 Hours]

Scheduled and unscheduled maintenance - Planning and scope - Evaluation of PMI programme – Work scheduling - Overtime - Breakdown analysis - Control of repair backlogs - Cost of options**.**

UNIT III

Vehicle Parts, Supply Management and Budget [L 9 Hours]

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. Model - Computer controlling of fleet activity - Energy management.

UNIT-IV

Scheduling and Fare Structure [L 8 Hours]

Route planning - Scheduling of transport vehicles - Preparation of timetable – preparation of vehicle and crew schedule - Costs, fare structure – Fare concessions - Methods of fare collection - Preparation of fare table.

UNIT V

Motor Vehicle Act [L 9 Hours]

Schedules and sections - Registration of motor vehicles - Licensing of drivers and conductors - Control of permits - Limits of speed - traffic signs - Constructional regulations - Description of goods carrier, delivery van, tanker, tipper, municipal, fire fighting and break down service vehicle.

BOOKS and REFERENCES:

1. John Dolu, Fleet Management, McGraw-Hill Co., 1984
2. Government Publication, The Motor vehicle Act, 1989.
3. Rex W Faulks, Bus and Coach Operation, Butterworth, 1987.
4. Kitchin L.D., Bus operation, 3rd Edition, llliffe and Sons Ltd., London, 1992.
5. Kadiyali L.R., Traffic engineering and Transport Planning.
6. Bus operation -L.d kitchen, iliffe& sons
7. Bus & coach operation -Rex w. fautks. Butter worth version of 1987

B. Tech Automobile Engineering
Evaluation Scheme

SEMESTER- VII

Sl. No.	Code	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1		HSMC-1/HSMC-2	3	0	0	30	20	50		100		150	3
2		Departmental Elective-IV	3	0	0	30	20	50		100		150	3
3		Departmental Elective-V	3	0	0	30	20	50		100		150	3
4		Open Elective-II	3	0	0	30	20	50		100		150	3
5		Lab-1	0	0	2				25		25	50	1
6		Mini Project or Internship Assessment*	0	0	2				50			50	1
7		Project	0	0	8				150			150	4
8		MOOCs (Essential for Hons. Degree)											
		Total	**9**	**0**	**12**	**21**						**850**	**18**

***The Mini Project or internship (5 - 6 weeks) conducted during summer break after VI semester and will be assessed during VII semester.

SEMESTER- VIII

Sl. No.	Code	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1		HSMC-2/HSMC-1	3	0	0	30	20	50		100		150	3
2		Open Elective-III	3	0	0	30	20	50		100		150	3
3		Open Elective-IV	3	0	0	30	20	50		100		150	3
4		Project	0	0	18				100		300	400	9
5		MOOCs (Essential for Hons. Degree)											
		Total	**9**	**0**	**18**	**27**						**850**	**18**

Semester – VII: Departmental Elective – IV: Specialization – Automobile Engineering

Subject Code: KAU 071	Automotive Pollution and control	L T P : 3 0 0	Credits: 3

The students will be able to		Blooms Taxonomy
CO-1	Understand formation of various type engine emissions, their effect on human health & environment and protocols for controlling carbon emissions.	K2
CO-2	Understand the types of emissions from spark and compression ignition engines.	K2
CO-3	Understand the different technologies used in SI and CI engines for reducing engine emissions.	K2
CO-4	Understand various after-treatment devices used for reducing tail pipe emissions according to Bharat Stage norms for various categories of vehicles.	K2
CO-5	Understand various emission standard procedures used for testing the emissions from various categories of vehicles.	K2
CO-6	Understand the various equipments used for measurement of exhaust emissions.	K2

Unit-1 **[L 8 Hours]**

Engine emissions and air pollution: Constituents of engine exhaust responsible for air pollution and their effect on human health, ozone layer depletion and global warming, Photochemical smog, greenhouse gases, Kyoto protocol and carbon trading.

Formation of Pollutants: Combustion generated and other pollutants, general mechanisms and kinetics of formation of carbon- monoxide, unburnt hydrocarbon, oxides of nitrogen and particulate matter due to combustion, effect of air-fuel ratio on emissions, Zeldovitch mechanism for formation of NOx, soot and smoke formation. NOx particulate trade-off.

Unit- 2 **[L 7 Hours]**

Emissions from Spark ignition engines: Types of emission form spark ignition engines, importance of mixture formation, lean and rich mixture, study of various mechanism of formation of unburnt hydrocarbon, effect of various design and operating variables on formation of CO, UBHC and NOx.
Discussion on different technologies used for reducing engine out emissions from a spark ignition engine, gasoline port injection and gasoline direct injection, Evaporative emissions and their control, HCCI operation of Gasoline engines.

Unit-3 **[L 7 Hours]**

Emissions from Compression Ignition engines: Types of emissions from compression ignition engine, effect of various design and operating variables on formation of NOx, smoke and particulate matter.
Discussion of various technologies for reducing engine out emissions from a compression ignition engine such as turbo charging, inter- cooling, fuel injection pressure, injection timing retard, exhaust gas recirculation, HCCI operation of Diesel engines.

Unit-4 **[L 9 Hours]**

Exhaust After treatment: Need for exhaust after treatment, fundamentals of catalytic converters, three-way catalyst, diesel oxidation catalyst, catalyst deactivation (contamination and poisoning, thermal deactivation), diesel particulate filter, effect of fuel sulphur on after treatment devices, Selective Catalyst Reduction.

Emission Test Procedures: Test cycles (USEPA Emission Test Cycle, European Emission Test Procedure, Japan Cycle) for emission testing of two three wheelers, passenger cars, utility vehicles, light and heavy duty commercial vehicles. Test procedures (USEPA, European and Evaporative Emission Standards) for various types of evaporative emissions.

Unit-5 **[L 8 Hours]**

Study of Emission Stages: Bharat Stage I, II, III, IV and VI for two-three wheelers, passenger cars, utility vehicles, light and heavy duty commercial vehicles used in India and Europe.

Equipment for Emission Measurements: NDIR analyzers, Flame ionization detector, chemiluminescence analyzer, constant volume sampling, measurement of smoke and particulate matter.

Text Book:

1. Pundir. B.P., “IC Engines Combustion and Emissions” Narosa Publishers, 2010.

Reference Books:

1. Ramalingam. K.K., “Internal Combustion Engines”, Scitech Publications, 2003.
2. SAE Transactions, “Vehicle Emission”, 3 Volumes, 1982. 4. Obert,E.F., “Internal CombustionEngines”, 1982.
3. Taylor,C.F., “Internal Combustion Engines”, MIT Press, 1972.
4. Heywood,J.B., “Internal Combustion Engine Fundamentals”, McGraw Hill Book Co., 1995.
5. Automobiles and Pollution SAE Transaction, 1995.
6. Springer and Patterson, “Engine Emission”, Plenum Press, 1990.

Semester – VII: Departmental Elective – IV: Specialization – Automobile Engineering

Subject Code: KAU 072	Hybrid Vehicle Propulsion	L T P : 3 0 0	Credits: 3

The students will be able to		Blooms Taxonomy
CO-1	Understand the basics of the hybrid electric vehicles and it's types.	K2
CO-2	Understand the types of drive trains used in hybrid vehicles	K2
CO-3	Understand the propulsion units used in Hybrid Vehicles and their efficiency.	K2
CO-4	Understand the requirements and devices of energy storage used in hybrid vehicles.	K2
CO-5	Understand the concept of downsizing of IC engines in case of hybrid vehicles.	K2
CO-6	Understand the principles of energy management and issues related to these strategies.	K2

UNIT I

Introduction to Hybrid Electric Vehicles: [L-4 Hours]

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Conventional Vehicles: [L-4 Hours]

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

UNIT II

Hybrid Electric Drive-trains: [L-4 Hours]

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Drive-trains: [L-4 Hours]

Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT III

Electric Propulsion unit: [L-10 Hours]

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV

Energy Storage: [L-5 Hours]

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Sizing the drive system: **[L-4 Hours]**

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

UNIT V

Energy Management Strategies: **[L-8 Hours]**

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Text Books:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press , 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press , 2004.

Reference Books:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley , 2003.
2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons Ltd., 2011.

Semester – VII: Departmental Elective – V: Specialization – Automobile Engineering

Subject Code: KAU 073	Vehicle Body Engineering & safety	L T P : 3 0 0	Credits: 3

The students will be able to		Blooms Taxonomy
CO-1	Understand the classification of the vehicles on the basis of body.	K2
CO-2	Understand the importance of material selection in designing automotive bodies.	K2
CO-3	Understand the concepts of aerodynamics used in designing automobiles.	K2
CO-4	Understand the importance of interior and exterior ergonomics while designing the vehicle.	K2
CO-5	Identify various sources of noise and methods of noise separation and various safety aspects in a given vehicle.	K2
CO-6	Calculate various aerodynamic forces and moments acting on vehicle, load distribution in vehicle body and stability of vehicle.	K3

UNIT-I:

Classification of Coachwork: [L-9 Hours]

Styling forms, coach and bus body style, layout of cars, buses and coach with different seating and loading capacity, types of commercial vehicles, vans and pickups, etc. Terms used in body building construction, angle of approach, Angle of departure, ground clearance, Cross bearers, floor longitudes, posts, seat rail, waist rail, cant rail, Roof stick, Roof longitude, Rub rail, skirt rail, truss panel, wheel arch structure, wheel arch, post diagonals, gussets.

UNIT-II:

Vehicle Body Materials: [L-9 Hours]

Aluminum alloys, Steel, alloy steels, plastics, Metal matrix composites, structural timbers - properties, glass reinforced plastics and high strength composites, thermoplastics, ABS and styrenes, load bearing plastics, semi rigid PUR foams and sandwich panel construction. Paints adhesives and their properties, corrosion and their prevention.

UNIT-II:

Aerodynamics: [L-5 Hours]

Basics, Vehicle drag and types, Various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, Principle of wind tunnel technology, flow visualization techniques, tests with scale models, aerodynamic study for heavy vehicles.

Load Distribution: [L-5 Hours]

Type of body structures, Vehicle body stress analysis, vehicle weight distribution, Calculation of loading for static loading, symmetrical, longitudinal loads, side loads, stress analysis of bus body structure under bending and torsion.

UNIT-IV:

Interior Ergonomics: **[L-4 Hours]**

Introduction, Seating dimensions, Interior ergonomics, ergonomics system design, seat comfort, suspension seats, split frame seating, back passion reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout. Visibility, regulations, drivers visibility, methods of improving visibility, Window winding and seat adjustment mechanisms.

Vehicle Stability: **[L-4 Hours]**

Introduction, Longitudinal, lateral stability, vehicle on a curvilinear path, critical speed for toppling and skidding. Effect of operating factors on lateral stability, steering geometry and stabilization of steerable wheels, mass distribution and engine location on stability.

UNIT-V:

Noise and Vibration: **[L-5 Hours]**

Noise characteristics, Sources of noise, noise level measurement techniques, Body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression.

Impact protection: **[L-5 Hours]**

Basics, physics of impact between deformable bodies, design for crash worthiness, occupant and cargo restraint, passive restraint systems, side impact analysis, bumper system, energy absorbent foams, laws of mechanisms applied to safety**.**

Books &Reference:

1. Bosch, “Automotive Handbook”, 8th Edition, SAE publication, 2011.
2. Powloski J., “Vehicle Body Engineering”, Business books limited, London, 1969.
3. Ronald K. Jurgen, “Automotive Electronics Handbook”, Second Edition, McGraw-Hill Inc., 1999.
4. Vehicle body engineering Giles J Pawlowsky Business books limited 1989
5. Vehicle body layout and analysis John Fenton Mechanical Engg. Publication ltd, London. 1990
6. Vehicle Safety 2002 Cornwell press Town bridge, UK ISBN 1356 – 1448
7. Aerodynamics of Road Vehicles W.H. Hucho Butter worth’s 1987 4th Edition.

Semester – VII: Departmental Elective – V: Specialization – Automobile Engineering

Subject Code: KAU 074	Trouble Shooting, Service & Maintenance Repair	L T P : 3 0 0	Credits: 3

The students will be able to		Blooms Taxonomy
CO-1	Understand types of maintenance procedures used in automobiles.	K2
CO-2	Understand the common garage practices and factors affecting efficiency of garage.	K2
CO-3	Understand the procedure of engine dismantling, inspection, common problems and remedies.	K2
CO-4	Understand the procedure of chassis and driveline components maintenance, inspection, common problems and remedies.	K2
CO-5	Understand the procedure of electrical system maintenance, inspection, common problems and remedies.	K2
CO-6	Understand basic principles of body work, paint of automobile vehicles and their safety measures.	K2

UNIT I: Automobile Maintenance [L 6 Hours]

Importance of maintenance, scheduled and unscheduled maintenance, preparation of check lists, analysis of breakdown, preventive measures, unit replacement system, maintenance schedule, chassis lubrication schedule, component retrieval, estimating repair cost, maintenance record, warranty period, servicing. Inspection forms, Log books, Trip sheets, other maintenance record forms.

Garage Practice: [L 2 Hours]

Types of servicestation/garage, layout of garage, Factors affecting layout, tools & equipment's, transport service undertakings, designa layout for different garage.

UNIT II: Engine Maintenance [L 10 Hours]

Dismantling of engine components, cleaning methods, visual inspection and dimensionalcheck of various engine components, minor and major tune up, reconditioning and repairing methods of engine components, Assembly procedure, special tools used for maintenance, repair and overhauling, Cooling Systems, Anti corrosion and antifreeze solutions, radiator, and thermostat, Lubrication oil topping up, oil change, oil relief valve, fuel feed systems, FIP adjustment and testing, injector testing. Common problems and their remedies.

UNIT III: Chassis and Drive Line Maintenance [L 8 Hours]

Mechanical type gear box, Automatic type gear box, Final reduction, propeller shaft, front and rear suspension systems, Brake systems: hydraulic, servo, air etc., Air bleeding, steering system, axles, wheel alignment, tires. Common problems and their remedies.

UNIT IV: Electric System Maintenance [L 5 Hours]

Battery testing method, starter motor, Electric horn, wiper motor, flasher, electric fuel pump, gauges, Lighting system, head lights focusing, wiring harness testing, Common problems and their remedies.

Charging system: [L 4 Hours]

DC generator, AC alternator, regulator, Ignition system: coil ignition, transistor assisted ignition, capacitor discharge ignition testing method and procedure. Common problems and their remedies.

UNIT V: Body Repair **[L 8 Hours]**

Minor body panel beating, tinkering, shouldering, Painting: Introduction of automotive paints, types of paints, corrosion and anticorrosion method, rubbing, polishing, working of paint booth, door lock mechanism, window glass actuation mechanism.

Books and References

1. John Doke "Fleet Management", McGraw-Hill Co. 1984.
2. Maleev. V.L., "Diesel Engine operation and Maintenance", Maintenance, McGraw Hill book Co., New York, 1954.
3. Judge. A.N., "Motor vehicle engine servicing, 3rd, Edition", Pitman Paper pack, London,1969.
4. Judge. A.W., "Maintenance of High speed diesel engines", Chapman Hall Ltd., London, 1956.
5. John. W. Vale. J.R., "Modern Auto Body and Finder repair".
6. Venk. Spicer. "Automotive Maintenance and Troubleshooting".
7. "Vehicle Service Manuals of reputed manufactures".