GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: AUTOMOBILE ENGINEERING (02)

SUBJECT NAME: AUTOMOBILE COMPONENT DESIGN

Subject Code: - 2170202

B.E 7th SEMESTER

Type of Course: - Advanced / Application

Pre-requisite:- Automobile engine, Automobile Transmission and Machine Design and Industrial Drafting.

Course Objective: - To make student get acquainted with to standardize the automobile part after designing the component like gear, gear box, piston, connecting rod, piston pin, crank shaft, valve mechanism, Cylinder liner, flywheel etc and to select the required bearing for same by considering the different design considerations.

Teaching and Examination Scheme:

TEACHING SCHEME				EXAMINATION MARKS					
				THEORY MARKS			PRACTICAL MARKS		TOTAL MARKS
LECT.	TUT.	PRAC.	CREDITS	ESE (E) 3 Hrs	PA (M)		VIVA (V)	PA (I)	
					PA	ALA			
4	0	2	6	70	20	10	30	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning; RP: Review Presentation.

CONTENT:-

Sr. No.	Course Content	Total Hours	% Weightage
1	**standardization in automobile system design** Preferred numbers – preferred series – derived series- and their applications in design.	4	**7%**
2	**Design Considerations** : Manufacturing and assembly considerations, Design of components for casting, welding, forging, hot and cold working, machining etc. assembly considerations in design. Design for Fatigue and Creep – thermal considerations – wear considerations in design – Human considerations in design.	9	**15%**
3	**Design of Bearings:** Bearing Identification/Designations. **Rolling Contact Bearing:** Types of rolling contact bearings, static and dynamic load capacities, Stribeck's Equation, Equivalent bearing load, load life relationship, Bearing life, Load factor, Selection of bearings from manufacturers catalogue. Lubrication and mountings, dismounting and preloading of bearings, Oil seals and packing. **Sliding Contact Bearings:** Bearing material and their properties, Bearing types and their constructional details, Hydrodynamic Lubrication- Basic theory, Design consideration in hydrodynamic bearings, Raimondi and Boyd method relating bearing variables.	**07**	**12%**
4	**Design of Gears:** Types of gears, Design consideration of gears, material selection,	**14**	**23%**

	Types of gear failures, Gear lubrication. **Spur Gears**: Force analysis, Number of teeth, Face width & Beam strength of gear tooth. Dynamic tooth load. Effective load on gear tooth. Estimation of module based on beam strength. Wear strength of gear tooth. Estimation of module based on wears strength. Spur gear design for maximum power transmission. **Helical Gears**: Virtual number of teeth, Tooth proportions, Force analysis, Beam strength of helical gears, Effective load on gear tooth, Wear strength of helical gears, Design of helical gears **Bevel Gears**: Terminology of bevel gears, Force analysis, Beam strength of bevel gears, Wear strength of bevel gear, Effective load on gear tooth, Design of bevel gear. **Worm Gears**: Force analysis, Friction in worm gear, Vector method, Strength rating of worm gears, Wear rating of worm gear.		
5	**<u>Design of Gearbox</u>** Design considerations of gearbox, selection of proper gear ratios for an automobile gearbox, design of shafts, splines, and gears for gear box used in automobiles.	**08**	**13%**
6	**Design of I.C. Engine Components:** - Engine power requirements, Selection of engine type, Stroke & Bore, compression ratio, clearance volume and swept volume, mean piston speeds. - Design of Piston & Piston pin: Materials used, design of piston crown, pin dimensions. - Design of Crank shaft & Connecting Rod -Forces, material, types, design criteria, dimensions etc. - Design of main journal bearing pin and connecting rod bearing pin of Crank shaft. - Main journal bearing and connecting rod bearing (small end & big end), Cam shaft bearings: Bearing materials, design criteria, types and dimensions. - Cylinder block dimensions, Types of liner– Dry & Wet type. - Valve mechanism Design: Valve, rocker arm, Valve spring design, Push rod, cam shaft and cam follower etc. - Design of cylinder head: Stresses, materials, Combustion chamber design. - Flywheel types & construction, criteria of design for solid and rim type. - Selection of Engine layouts. - Design Criteria of intake manifold and exhaust manifold. Introduction to CFD analysis (flow & thermal impact related inputs and outcome). - Engine lubrication system and pumps.	**18**	**30%**
	Total	**60**	**100%**

SUGGESTED SPECIFICATION TABLE WITH MARKS (THEORY):

Distribution of Theory Marks				
R Level	**U Level**	**A Level**	**N Level**	**E Level**
10	**10**	**15**	**11**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyse and E: Evaluate

NOTE: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

ReferenceBooks:

1. Elements of Motor Vehicles Design by D T Bdonkins, TMH
2. Automobile Chassis Design and calculations by P. Lukin, Mir Publishers
3. Auto design Problems by K. M. Agrawal, Satya prakashan.
4. Automotive Mechanics by N. K. Giri, Khanna Publishers
5. Machine Design by Sadhu singh, Khanna Publishers
6. Automobile Chassis Design by Dean Averns,Lllife Books Ltd (1992)
7. Automobile Engg. Vol-I & II by Kirpal Singh, Standard Pub.
8. Automobile Engg. Vol-I & II by K.M.Gupta, Umesh Pub.
9. Auto Design by R. B. Gupta, Satya Prakashan
10. "Mechanical Engineering Design", Fourth Edition, by Joseph E. Shigley & Larry D.Mitchell,McGraw-HillInternationalBookCompany
11. Design of Machine Elements by Bhandari, Tata McGraw-Hill Publishing Company Ltd
12. Machine Design by, Sharma and Agrawal, S. K. Kataria & Sons
13. Transmission System Design by R. B. Patil, Tech Max Pub, Pune.
14. Machine Design Vol-II & III by F.Haideri, Nirali Prakashan, Pune.
15. PSG Design Data Book.
16. Automotive Chassis by P. M. Heldt, Chilton Co., NY(1992)
17. Machine Design by Pandya and Shah, Charotar Publishing House.
18. Machine Design by R. S. Khurmi, J. K. Gupta, Schand & Co.
19. Bearing Manufacturers Catalogues.

LIST OF PRACTICALS:

The term work shall be based on the topics mentioned above and one component assembly must be design and sheet must be drawn for assembly and parts.

1. To standardize the given automobile part for size, torque and power point of view.
2. To design the **spur, helical, bevel and worm gear** for given situation of automobile vehicle.
3. To design the **gear box** for given situation of automobile vehicle.
4. To design the **engine cylinder** for given situation of automobile vehicle.
5. To design the **piston** for given situation of automobile vehicle.
6. To design the **flywheel** for given situation of automobile vehicle.
7. To design the **valve and valve mechanism** for given situation of automobile vehicle.
8. To design the **connecting rod** for given situation of automobile vehicle.
9. To select the bearing for given situation to support the rotating/sliding part of an engine.
10. To give reason of design considerations during the above part and assembly design for which you made assumptions.

COURSE OUTCOME:

1. Student will be able to select and design the different automobile components.
2. Student will be able to standardize the different parts.
3. Student will be able to give reasons of assumptions made while designing the component with reference to manufacturing assembly, thermal and wear considerations point of view.

LEARNING ASSIGNMENTS:

Preparation of power-point slides, which can include mathematical calculations, videos, animations, pictures, graphics for better understanding of theory and practical work . The faculty will allocate chapters/ parts of chapters to various groups of students so that the entire syllabus can be covered. The power-point slides should be made available on the College/ Institute's web-site along with the name of the students, faculty, Department and College on the first slide. Best three presentations should be submitted to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Automobile Engineering (02) and Mechanical Engineering (19)
SUBJECT NAME: Vehicle Dynamics
SUBJECT CODE: 2170203
B.E. 7th SEMESTER

Type of course: Application

Prerequisite: ---

Rationale: To understand the principle and performance of vehicle in various modes such as longitudinal, vertical and lateral directions. At the end of the course the student will be able to identify the various forces and loads and performance under acceleration, ride and braking.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Performance Characteristics of Vehicle:** SAE Vehicle axis system, Forces & moments affecting vehicle, Earth Fixed coordinate system, Dynamic axle loads, Equations of motion, transmission characteristics, vehicle performance, power limited and traction limited acceleration, braking performance, Brake proportioning, braking efficiency.	6	15
2	**Aerodynamics:** Mechanics of Air Flow Around a Vehicle, Pressure Distribution on a Vehicle, Aerodynamic Forces, Drag Components, Aerodynamics Aids.	4	10
3	**Tire Mechanics:** Tire Construction, Size and Load Rating, Terminology and Axis System, Tractive Properties, Cornering Properties, Camber Thrust, Aligning Moment, Combined Braking and Cornering, Conicity and Ply Steer, Slip, Skid, Rolling Resistance, Elastic Band Model for longitudinal slip, Simple model for lateral slip, Combined longitudinal/lateral slip (friction ellipse), Taut string model for lateral slip, Magic Tire Formula	7	15
4	**Suspensions:** Suspension Kinematics, Suspension types, Solid Axles, Independent Suspensions, Anti-Squat and Anti-Pitch Suspension Geometry, Anti-Dive Suspension Geometry, Roll Center Analysis, Suspension Dynamics, Multi-body vibration, Body and Wheel hop modes, Invariant points, Controllable Suspension Elements: Active, Semi-Active. Choice of	8	20

	suspension spring rate, Calculation of effective spring rate, Vehicle suspension in fore and apt directions.		
5	**The Steering System:** The Steering Linkages, Steering System Forces and Moments, Steering System Models, Steering Geometry, Steady Handling (2 DOF steady-state model), Understeer and Oversteer, Effect of Tire Camber and Vehicle Roll (3 DOF steady-state model), Transient Handling and Directional Stability (2 DOF unsteady model), Effect of Vehicle Roll on Transient Handling (3 DOF unsteady model), Steady-State and Transient Handling of Articulated Vehicles.	8	20
6	**Rollover:** Quasi-Static Rollover of a Rigid Vehicle, Quasi-Static Rollover of a Suspended Vehicle, Transient Rollover	4	10
7	**Motorcycle Dynamics:** Kinematic structure of motorcycle, geometry of motorcycles, importance of trail, Resistance forces acting on motorcycle (tyre rolling resistance, aerodynamic resistance forces, resistant force caused by slope), Location & height of motor cycle's centre of gravity (C.G), Moments of inertia on Motorcycle. Introduction to Front & Rear suspensions of Motorcycle.	5	10

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	10	15	20	10	5

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Hans Pacejka, Tire and Vehicle Dynamics, Elsevier, 2012.
2. Thomas D Gillespie, "Fundamentals of Vehicle dynamics", SAE USA 1992.
3. Rajesh Rajamani, Vehicle Dynamics & control, Springer.
4. R.V. Dukkipati, Vehicle dynamics, Narsova Publications.
5. Wong J Y, "Theory of Ground Vehicles", John Wiley & Sons, New York, 1978.
6. Milliken W F and Milliken D L, Race car Vehicle Dynamics, SAE.
7. Garrett T K, Newton K and Steeds W, "Motor Vehicle", Butter Worths & Co., Publishers Ltd., New Delhi, 2001.
8. Heinz Heister, "Vehicle and Engine Technology", SAE Second Edition, 1999.
9. Vittore Cossalter, Motorcycle Dynamics, 2nd Edition, Publisher: LULU.com
10. R N Jazar, Vehicle Dynamics: Theory and Application, Springer.

Course Outcome:

After learning the course the students should be able to:

- Understand the dynamics of vehicle ride

- Calculate and refer the loads and forces associated to the vehicles
- Analyse the behavior of the vehicles under acceleration, ride and braking

List of Experiments:

1. Experimental study of mechanism for air flow over different geometry of vehicles.
2. Experimental studies of measurements of drag and lift coefficient for different geometry vehicle using wind tunnel apparatus.
3. To study the effect of tyre pressure and temperature on the performance of the tyre.
4. To simulate and study a quarter car models using MBD (Multi Body Dynamics) software.
5. To simulate and understand behaviour of sprung / un-sprung mass & lumped mass system MBD software.
6. Finding the stiffness of tyre with variation of air pressure.
7. To simulate and study the effect of different conditions on vehicle loading.
8. Study of latest technologies available nowadays in vehicles helping to maintain stability of the vehicle on the road.
9. Study geometry of motorcycles as well as various types of forces faced by the motorcycle & its rider
10. Study the location & height of Centre of gravity (C.G) of a motorcycle

Design based Problems (DP)/Open Ended Problem:

- To design/check aerodynamics shapes of various car bodies, to calculate equivalent weight and maximum acceleration, desired power to propel the vehicle by CFD analysis.

Major Equipment:

- Wind tunnel apparatus
- Multibody (MBD) simulation software

List of Open Source Software/learning website:
http://nptel.ac.in/courses/107106080/

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: AUTOMOBILE ENGINEERING (02)

SUBJECT NAME: VEHICLE TESTING AND HOMOLOGATION
SUBJECT CODE: 2170204

B.E. 7th SEMESTER

Type of course: Under Graduate

Prerequisite: Automobile Engineering fundamentals

Course objective:
The number of rules and norms applying to automobiles has increased globally due to increased emphasis on safety and environmental protection. Newly designed automobiles or automobile models are to be tested thoroughly for its performance and safety before it reaches to the users. Automotive homologation is the activity of certifying vehicles and every component fitted in a vehicle has to satisfy the requirements set by various statutory / regulatory bodies. It is mandatory to get approval for export of automobile products or its components. This subject will give preliminary idea regarding some of the practices and standards followed in automobile industry for their testing and homologation.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Total Credits	Theory Marks		Tutorial / Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE(E)	PA (M)	Viva (V)	PA(I)	
4	0	2	6	70	30	30	20	150

Course Content

Sr. No	Content	Total Hrs.	% Weightage
1.	**Introduction:** Need of vehicle testing and homologation, Vehicle testing organizations, Hierarchy of testing: Individual component approval, System level approval and Whole vehicle approval. Type Approval & Conformity of Production tests.	**02**	**03**
2.	**Engine ,Fuel systems and Emissions Testing:** Laboratory testing of basic engine parameters: Measurement of BHP, IHP, Engine testing on dynamometers, different types of dynamometers- hydraulic, eddy current etc., engine analyzers- for petrol and diesel engines, FIP calibrating and testing, Emission test for CO, HC, NOx, CO_2, PM, etc. using exhaust gas analyzers, their types. Orsat apparatus, infrared gas analyzers, smoke meter.	**07**	**14**

3.	**Noise vibration and Harshness Testing:** Review of vibration fundamentals, vibration control, fundamentals of acoustics, human response to sound, automotive noise criteria, Standard noise measurement methods, Noise inside and outside the vehicle, sources of vehicle noise- intake and exhaust noise, combustion noise, mechanical noise, noise from auxiliaries, wind noises, transmission noises, brake squeal, structure noise, noise control methods. Pass by Noise testing method.	**07**	**14**
4.	**Vehicle Performance Testing:** Methods for evaluating vehicle performance- energy consumption in conventional automobiles, performance, emission and fuel economy, Operation of full load and part load conditions, effect of vehicle condition, tyre and road condition and traffic condition and driving habits on fuel economy, Gradability test, Turning circle diameter test, Steering Impact test, Steering effort test.	**06**	**15**
5.	**Road and track testing:** Initial inspection, PDI, engine running in and durability, intensive driving, maximum speed and acceleration, brake testing on the road, hill climbing, handling and ride characteristics, safety, mechanism of corrosion, three chamber corrosion testing, wind tunnel testing, road testing, test tracks.	**06**	**14**
6.	**Vehicle testing on chassis dynamometers:** Two wheel & four wheel dynamometers, vehicle testing lanes - side slip testers, wheel alignment testing, wheel balancing, brake test, head light alignment and light intensity testing.	**06**	**15**
7.	**Active and Passive Safety testing:** Wheel rim testing for cornering and radial fatigue, Fire resistance test, bumper test, crash test, side impact test, rollover test, safety belt test, Airbag test, Safety belt anchorages, Seat anchorages & head restraints, Occupant protection Impact test, Side door intrusion test.	**06**	**15**
8.	**Automobile testing standards:** Introduction, overview and study of testing standards like; AIS testing standards, Euro Standards, SAE standards. ISO26262 standards for functional safety of electrical and/or electronic systems in automobiles. ***Understanding of some AIS Standards:*** AIS-008 (Installation requirements of lighting and light-signaling devices for motor vehicles having more than three wheels, trailer and semi-Trailer excluding agricultural tractor and special purpose vehicles), AIS-018:2001 (Automotive Vehicles - Speed limitation Devices – Specifications), AIS-037 (Procedure for Type Approval and establishing conformity of production for safety of critical components), AIS-093 (Code of practice for construction and approval of truck cabs & truck bodies), AIS-003 (Automotive Vehicles - Starting Gradeability - Method of Measurement and Requirements), AIS-038 (Battery Operated Vehicles – Requirements for Construction and Functional Safety).	**06**	**10**

Suggested Specification table with Marks (Theory): Distribution of Theory Marks

R Level	U Level	A Level	N Level	E Level	C Level
10	**15**	**15**	**10**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Raymond M. Brach and R. Matthew Brach, "Vehicle Accident Analysis and Reconstruction Methods", SAE International, 2011
2. J. G. Giles – Vehicle operation and performance, Wildlife Publications, London, 1969.
3. W. H. Crouse and L. Anglin – Motor vehicle inspection, McGraw Hill Book Co. 1978.
4. Dr. N.K.Giri- Automotive technology – Khanna publishers, 2009
5. Ulrich Seiffert and Lothar Wech, "Automotive Safety Handbook", SAE International, 2007
6. ISO Standards, ICS: 43.020, 43.040, 43.100

List of suggested Practicals:

1. To study the performance characteristics of automobile petrol engine
2. To study the performance characteristics of automobile diesel engine
3. To study the performance characteristics of automobile engine operated on alternate fuel (CNG, LPG, Bio Diesel).
4. To study the performance characteristics of Electric.
5. To study the performance characteristics of Hybrid Electric vehicles.
6. Calibration of fuel injection pump and testing.
7. Calibration of Diesel Injectors.
8. Calibration of Petrol Injectors.
9. Head light beam alignment and testing.
10. Vehicle horn intensity testing.
11. Measurement of Brake stopping distance.
12. Vehicle testing on chassis dynamometers.
13. Analyze the emissions of petrol, diesel and CNG vehicles using exhaust gas analyzer.
14. Gradability test.
15. Turning circle diameter test.
16. Measurement of steering effort.
17. Pass by noise test.
18. Study of Bus Body code.

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: AUTOMOBILE ENGINEERING (02)

SUBJECT NAME: TRANSPORT MANAGEMENT AND LAWS
SUBJECT CODE: 2170205

B.E. 7th SEMESTER

Type of course: Advanced / application

Prerequisite:

Rationale: Subject will cover various transport management aspects and motor vehicle laws after studying this subject the students will be able to manage a transport fleet and their related activities for minimizing operational cost.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks		Practical Marks				
L	T	P	C	ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
4	0	0	4	70	30	0	0	0	0	100

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning; RP: Review Presentation

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction** Introduction to various transport systems, Advantages of motor transport, Staff administration, Recruitment and Training, welfare, driver's health and safety, Basic principles of supervising, Organizing time and people, Driver and mechanic hiring, economical and safe driving tips for city and highway, understanding of traffic rules, Trip leasing, Vehicle operation and types of operations.	6	10%
2	**Transport Management** Transport organization structure, operations, Planning Scheduling operation & control, Propaganda, publicity and passenger amenities Parcel traffic, General set up, transport industry, government / (STU) State Government Undertakings and private Bus transport organizations, Bus depot organisation structure, Truck fleet operators' organization, Requirements and Problems on fleet management. Firebrigade fleet and Ambulance operations management. 108 Organisational activities and it's benefits for the society.	12	18%
3	**Scheduling and fare structure**	10	

	Principal features of operating costs for transport vehicles, Fare structure, and Various types of fare collecting methods, Basic factors of bus scheduling, Problems on bus scheduling.		15%
4	**Planning for New Transport Organization** Geographical considerations, economic factors, vehicles used, planning of trips. Concept of BRTS operations. Organisation of Transport Services: Records and fleet management, vehicles 8schedule, booking and reservation, statistical records, recording of goods transport Scheduling of goods transport, Management Information System (MIS) in passenger / goods transport operation. Storage & transportation of petroleum products, Advanced Techniques in Traffic Management, Traffic navigation, Global positioning system. Study of BRTS concept, sysrem and management. It's advantages and disadvantages interms of mass transportation.	14	21%
5	**Motor Vehicle Act** Acts & definitions, Licensing of drivers and conductors, registration of vehicles, control of transport, RTO and other regulations, offences, penalties and procedures, types of form and procedures, licensing of taxies and buses, rules and regulations, testing and passing of vehicles. Description of goods carrier, delivery van, tanker, tipper, municipal, fire fighting and break down service vehicle. Taxation: Structure, method of laying taxation, goods vehicle taxation, passenger vehicle taxation, mode of payment, tax exemption, one / life time taxation. Service Life of vehicles. Toll tax reasons & operational management. Build Operate Transfer arrangement. Highway traffic rules, Taffic signs, Natinal and international driving conditions / rules.	10	16%
6	**Accident & Prevention** Vehicle accident, laws, injury, safety precautions, road transport regulations. **Insurance** Insurance & Finance Classes/types of insurance, accident claims and settlements, duty of driver in case of accident, hire purchase.	6	10%
7	**Laws Related to Pollution Under Control (PUC):** Pollution Under control certification agency, Authority & procedure for PUC certification agency. Harmful exhaust gas constituents, permissible limits, Euro / Bharat Stage -I, II, III, IV norms and implementation, testing and measurements. Study of Odd-Even formula, high power to weight ratio & higher capacity diesel vehicles and other possible methods for reduction of atmospheric pollution and it's impact.	6	10%

Suggested Specification table with Marks (Theory): Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
9	**13**	**17**	**11**	**12**	**8**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Motor Vehicles Acts, Law Publishers
2. Schumer, Economics of transport, T.M.H.
3. Fair and Williams, Economics of transportation, East West Press.
4. Hudson, Motor transportation, T.M.H.
5. M.V. Act 1988-RTO rules and regulation manual.
6. Fuel Economy of Motor Vehicle, Allied Publishers.
7. National Research Council, Automotive Fuel Economy, National Academic Press.
8. CIRT Journal of Transport Management
9. John Duke - Fleet Management – McGraw-Hill Co, USA -1984.
10. Kitchin.L.D., - Bus Operation - Illiffee and Sons Co., London, III edition – 1992

Course Outcome:

After learning the course the students should be able to:

- Understand and have knowledge about different aspects related to transport system and will be able to manage.
- Understand various Features of scheduling, fixing the fares.
- Understand various types of insurance and taxation policies.
- Know about the motor vehicle act and laws related to PUC Norms.

Design based Problems (DP)/Open Ended Problem (OEP):

- Group Discussion / Technical Debate on advanced topics.

List of Open Source Software/learning website:

1. http://ocw.mit.edu/

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: AUTOMOBILE ENGINEERING (02)
SUBJECT NAME: VEHICLE MAINTENANCE & GARAGE PRACTICE
Subject Code: - 2170206
B.E 7th SEMESTER

Type of Course: - Advanced / Application

Pre-requisite:- Automobile System

Course Objective: The course is designed to understand maintenance methods/techniques and garage practices. Students will also be able to learn about different documents used and records required in modern service station.

Teaching and Examination Scheme:

Teaching Scheme				Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	70	30	30	20	150

L: Lectures; T: Tutorial; P: Practical; C: Credits; ESE: End Semester Examination; PA: Progressive Assessment.

CONTENTS:

Sr. No.	Course Contents	Total Hrs	% Weightage
1.	**Vehicular Maintenance Practices:** Requirements and importance of service & maintenance, Preventive, Predictive & Breakdown maintenance, daily, weekly and monthly maintenance schedule, Periodic maintenance scheduled chart.	06	15
2.	**Measuring Instruments:** Measuring instruments for wear, Fuel consumption, speed, acceleration, vibration, noise. Methods used for measurement of fuel consumption.	04	9
3.	**Garage Practices:** Types, functions, operations and activities of service stations. Layouts of modern service station/workshop. Criteria and	06	15

	requirements of service station and its layout. Study of service tools, measuring & gauging instruments and service/repair equipments with testing and repairing processes.		
4.	**(a) Maintenance & Overhauling of engine components:** Measurement of cylinder bore, cylinder boring and honing, liners fitting. Cylinder head facing, valve seat lapping. Adjustment of valve timing and fuel injection pump timing. Rocker arm gap adjustment/setting procedure. Tuning of carburetor. Fuel injection pumps and fuel injector's calibration. Engine Lubrication circuit and it components, Fuel supply circuit of petrol, Diesel, Bi-Fuel engines, Cooling system layout and its components, Air intake & Exhaust systems and components **(b) Maintenance & Overhauling of drive lines:** Adjustment of clutch, repair & replacement of clutch parts. Overhauling of all types of gear boxes. Repair & maintenance of Propeller shaft & universal joint. Differential back lash adjustment. Repair & maintenance of differential. Repair & maintenance of final drive/axles. **(c) Maintenance & Overhauling of various systems:** Lubrication and maintenance of suspension system. Study and adjustment of steering geometry; toe in, toe out, caster, camber, and king pin inclination. Maintenance of steering system. Maintenance of wheel and tyre. Tyre rotation, tyre re-treading, effect of tyre inflation & tyre wear. Wheel balancing. Maintenance of hydraulic brakes; brake adjustments and bleeding of brakes. Study of air brake circuit & system components. Maintenance of radiator and water cooling system. Maintenance of lubrication system; chassis greasing, wheel bearing greasing etc. Hydraulic and Air Brake circuits and its components. Maintenance of electrical system components. **(d) Diagnosis, Causes, and Remedies :** Causes & remedies of different problems related engine (high fuel consumption, high engine oil consumption, Over heating of engine), clutch, gearbox, propeller shaft, differential, final drive, brakes, suspension, steering, wheels & tires, battery, Starting circuit & Charging circuit etc. **(e) Maintenance & repair of vehicle body :** Maintenance of vehicle body; minor and major repairs. Body repair tools & equipments. Introduction to denting & painting process of vehicles.	**02** **06** **08** **02** **03**	**46**

5.	**Workshop management practices :** Study of Workshop documents & records like job cards, parts catalogue, parts price list, vehicle history sheet, warranty card, bill & billing procedure of vehicle, logbook of vehicle, customer satisfaction sheet, service book, etc. Activities and responsibilities of workshop management. Study of workflow in service station. Customer complaint Handling & consumer cases in case of any dispute.	**06**	**15**

References:

1. Automotive Mechanics by William H. Crouse & Donald L. Anglin; Tata McGrawHill Publishing Company Ltd.
2. Automobile systems by Anil Chikara, Satya Prakashan.
3. Automobile Engineering by K.K.Ramlingan, SciTech Publication.
4. Auto mechanics by Joseph Heitner, East West Press.
5. Automotive Service Basics by Pattern and Donald, Pearson Publications.
6. Vehicle Service book.
7. Vehicle Workshop Manual.
8. Parts Price List.
9. Parts catalogue of service station.
10. Job cards of modern service station.

List of experiments (any ten):

1. Study of modern workshop layout.
2. Study of different types of job cards & maintenance schedule chart.
3. Study of measuring, gauging & service equipments.
4. Demonstration on tyre inflator and hydraulic hoist.
5. Demonstration on tyre changer and car washer unit.
6. Performance on wheel balancer.
7. Performance on wheel aligner.
8. Cleaning and testing of petrol injector.
9. Cleaning and testing of different types of nozzles.
10. Bleeding of hydraulic brakes.
11. Overhauling of any component or system of a vehicle.
12. Study of different workshop documents & records.

List of equipments:

1. Hydraulic hoist
2. Electronic tyre inflator
3. Tyre changer
4. Wheel aligner
5. Wheel balancer
6. Petrol injector cleaner test setup
7. Diesel nozzle tester and cleaner setup
8. Measuring and gauging instruments

Course Outcomes:

1. Learning of maintenance types/techniques.
2. Learning of different garage equipments and practices.
3. Learning of workshop documents and records.

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Mechanical Engineering
SUBJECT NAME: Oil Hydraulics and Pneumatics
SUBJECT CODE: 2171912
B.E. 7th SEMESTER

Type of course: Elective
Prerequisite: None
Rationale: Course gives idea about the basic system working on fluid power and compressed air. Also different valves related to hydraulic and pneumatic systems are discussed in syllabus. Subject is also useful for designing the various hydraulic and pneumatic circuits for various engineering applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
3	0	2	5	70	30	20	10	10	10	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning;

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction:** Introduction, Global fluid power Scenario, Basic system of Hydraulics-Major advantages and disadvantages, Principles of Hydraulic Fluid power, Hydraulic Symbols, Electrical Elements used in hydraulic circuits.	5	10
2	**System Components, Hydraulic Oils, Fluid Properties and Filter:** Hydraulic & Pneumatic Symbols as per ISO/ANSI, Types, Properties, physical characteristics & functions of hydraulic Oils, Classification- Mineral based, Fire resistant& Biodegradable Oils, Filters, Contaminations, location of filter.	5	15
3	**Hydraulic Pumps, Motors and Actuators:** Construction, working principle and operation of rotary & reciprocating pumps like Gear, Vane, Generated-Rotor, Screw, Axial Piston, Radial Piston, Pump characteristics, Linear and Rotary Actuators, Hydrostatic Transmission Systems. Selection of components for applications.	6	20
4	**Hydraulic Valves and Hydraulic System Accessories:** Direction control valves, Pressure control valves, Flow control valves, Non-return valves, Reservoirs, Accumulators, Heating & cooling devices, Hoses. Selection of valves for circuits.	6	18
5	**Design of hydraulic circuits:** Basic hydraulic circuits, Industrial hydraulic circuits, Power losses in flow control circuits.	6	10
6	**Introduction to Pneumatic Systems:** Basic Requirements for Pneumatic System, Applications, Pneumatic fundamentals, Construction, working principle and operation of pneumatic power transmission system components like Power source, FRL unit, Actuators and control valves like DCV, FCV, PCV, time delay, quick exhaust, twin pressure, shuttle.	6	12
7	**Pneumatic circuits:** Basic pneumatic circuits, Development of single Actuator Circuits, Development of multiple Actuator Circuits, Cascade method for sequencing.	6	10
8	Introduction to Automation in hydraulic and Pneumatic Systems.	3	5

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	15	15	10	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Industrial Hydraulics by John Pippenger and Tyler Hicks, McGraw Hill.
2. Oil Hydraulic Systems, Principle and Maintenance by S R Majumdar, McGraw-Hill.
3. Fluid Power with Applications by Anthony Esposito, Pearson.
4. Fluid Power: Generation, Transmission and Control, Jagadeesha T., Thammaiah Gowda, Wiley.
5. The Analysis & Design of Pneumatic Systems by B. W. Anderson, John Wiley.
6. Control of Fluid Power Analysis and Design by Mc Clay Donaldson, Ellis Horwood Ltd.
7. Hydraulic and Pneumatic Controls: Understanding made Easy, K.Shanmuga Sundaram, S.Chand & Co Book publishers, New Delhi, 2006 (Reprint 2009)
8. Basic Pneumatic Systems, Principle and Maintenance by S R Majumdar**,** McGraw-Hill.
9. Basic fluid power Dudley, A. Pease and John J. Pippenger, , Prentice Hall, 1987

Course Outcome:

After learning the course, the students should be able to:

1. Identify and analyse the functional requirements of a power transmission system for a given application. (Application involving fluid power transmission)
2. Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application. Develop a circuit diagram.
3. Visualize how the hydraulic/pneumatic circuit will work to accomplish the function.
4. Selection and sizing of components of the circuit.

List of Experiments:

A. Experiments on Hydraulics Circuits:

1. Extend-Retract and Stop system of a linear actuator.
2. Regenerative circuit.
3. Speed Control circuits: meter-in, meter-out and bleed off.
4. Sequencing circuit
5. Use of solenoid operated DCV.
6. Rapid Traverse and Feed circuit.

B. Experiments on Pneumatic Circuits:

1. Study of Compressor, FRL unit and 5/3 DCV.
2. Reciprocating motion of a single and a double acting actuators using 5/3 DCV.
3. Speed control circuits.
4. Automatic to & fro motion of a pneumatic linear actuator.
5. Sequencing circuit.
6. Logical circuits using shuttle valve.

C. Students should build up the above circuits on computer using software and simulate the flow of fluid during the operation. Afterwards, they themselves can physically connect the circuit on the hydraulic/pneumatic trainer and run the circuit.

Design based Problems (DP)/Open Ended Problem: Student can be given an application of a power transmission system for which they can evaluate the functional requirements and design appropriate circuit. They must identify the components, and relevant parameters. The application must involve use of hydraulics/pneumatics and/or combinations of different power transmission systems.

Major Equipment:

1. A hydraulic trainer
2. A pneumatic trainer
3. Simulation Software

List of Open Source Software/learning website:

1. Autosim Premium
2. Hydrosym