

Automobile Engineering

Nagaland

TERM-V

MOTOR VEHICLE ACT

L T P
3 0 2

Curri. Ref. No. : AE-501

Total Contact hrs: **65**

Total Marks: **150**

Theory: **100**

Lecture: 45

End Term Exam: 75

Tutorial: 0

P.A: 25

Practical: 20

Practical: 50

Pre-requisite:

End Term Exam: 25

Credit: **4**

P.A: 25

Rationale:

Use of motor vehicle & their operations is regulated by motor vehicle act 1989 in India. The automobile engineers and of motor vehicle should have the knowledge of law pertaining to vehicles. Registration of motor vehicles, driving licence and vehicle are some of the important points to be understood. The most observe the highway, marking, traffic signs, signals, traffic laws and limits of speeds for the purpose, driving road rules, road traffic signals, precautions to be taken while overtaking, driving through corners and slopes, hand signals and limits of speeds are studied in this paper

DETAILED COURSE CONTENTS

UNIT	TOPIC/SUB-TOPIC	LECTURE Hrs
1.0	Work Profiles	3
	1.1 Assistant inspector of motor vehicle	
	1.2 Insurance surveyor	
	1.3 State transport Depot manager	
	1.4 Fleet scheduling supervisor	
2.0	Motor Vehicle Act 1989	15
	2.1 Need for Motor Vehicle act	
	2.2 Organization of motor vehicle department at National & State Level.	
	2.3 Licensing (procedure, conditions, and forms).	
	2.4 Two wheeler (Moped, Motor cycle), Four Wheeler (Light Motor Vehicle, Light Motor Vehicle Transport, Heavy, Passenger) and Special Vehicles viz. Tractor, Forklift etc.	
	2.5 Driving school license Procedure, Requirements and Curriculum	
	2.6 Vehicular pollution control- Petrol & Diesel license Procedure, Requirement	
	2.7 Conductors license (Eligibility & procedure)	
	2.8 Registration of motor vehicle- Necessity and types	
	2.9 Temporary registration- Need and procedure	
	2.10 Registration Need and procedure for various classes of vehicles.	
	2.11 Transfer of ownership and alteration in vehicle – procedure	
	2.12 Submission for ensuring fitness – need, conditions certificate of fitness-validity.	
	2.13 Suspension and cancellation of registration	
3.0	Carriage Permit	10
	3.1 Need	
	3.2 Validity	
	3.3 Types of carriage permits- stage and contract	
	3.4 Stage carriage permits - Definition and types	
	3.5 Procedure	

- 3.6 Requirements
- 3.7 Transfer & cancellation
- 3.8 Conditions in different types of Stage carriage of permits
- 3.9 Contract carriage permits - Definition and types
- 3.10 Procedure
- 3.11 Requirements
- 3.12 Transfer & cancellation

4.0 Taxation

7

- 4.1 Need
- 4.2 Two-wheeler (method & amount)
- 4.3 Four-wheeler ((method & amount)
- 4.4 Passenger tax ((method & amount)
- 4.5 Goods tax (method & amount)
- 4.6 Tax exemption (method & condition)

5.0 Motor Vehicle Insurance:

10

- 5.1 Introduction and classification of insurance.
- 5.2 Insurance regulatory authority in India. (Role and jurisdiction)
- 5.3 Various motor vehicle insurance organizations in India. (Role and area of specialisation)
- 5.4 Motor Vehicle Insurance
 - Comprehensive (meaning, types, various provisions, condition, premium calculation, bonus, risk cover)
 - Third Party (meaning, types, various provisions, condition, premium calculation, bonus, risk cover)
- 5.5 Assessment – old vehicle & Accident vehicle.
- 5.6 Accident claims settlement – Procedure.

Suggested Learning Resources Suggested

A) Books

Sr. No.	Title	Edition	Author/ Publisher
1.	Auto Insurance		The Chartered Insurance Institute Tuition Service.
2.	Auto body repairing and repairing		Bill Tobolt/ The Good Heart-Willcox Co. Inc, Home wood, Illinois
3.	Insurance		Verma and Agarwal/ Forward Book Depot Nai Sarak, Delhi.
4.	Elements of General Insurance		LIC Publications
5.	Motor vehicle act, 1988	12th	Eastern Book company, Lukhnow.
6.	S. Srinivasan		Automotive machines Tata Mc graw Hill Publishing Co. Ltd.

METROLOGY

L T P
3 0 2

Curri. Ref. No. : AE-409

Total Contact hrs: **75**

Total Marks: **150**

Theory: **100**

Lecture: 45

End Term Exam: **75**

Tutorial: 0

P.A: **25**

Practical: 30

Practical: **50**

Pre-requisite:

End Term Exam: **25**

Credit: **4**

P.A: **25**

Rationale

Diploma engineers often come across varied types of measuring instruments in the actual practice. Diploma engineer should be proficient in making the measurements and follow various control processes to maintain the quality in engineering manufacturing areas. He should be able to understand and analyze the practical measurement systems.

The course Metrology makes the students to understand the process of measurement required in any industry. Also the student should be able to select and use the appropriate measuring instruments for a particular application.

DETAILED COURSE CONTENTS

UNIT TOPIC/SUB-TOPIC

LECTURE Hrs

1.0 Metrology Concepts & Standards

- 1.1 Definition of Metrology common terminology used such as Accuracy,
- 1.2 Precision, Sensitivity, Magnification, Errors, Sources of errors.
- 1.3 Line standard
- 1.4 Wavelength standard

2.0 Basic, Precise & Non Precise Measuring Instruments

- 2.1 Surface plate, angle plate, V Block, Spirit level, straight Edge, slip gauges,
- 2.2 pitch screw gauge, feeler gauge,
- 2.3 Vernier caliper, vernier height gauge, vernier depth gauge, Outside
- 2.4 micrometer, inside micrometer, slip gauge.
- 2.5 Concept of calibration.

3.0 Limits, Fits & Gauges

- 3.1 Definitions -Tolerance, Allowance, Types of fits, Hole basic system & shaft
- 3.2 Basic system of fits.
- 3.3 Types of gauges -Plug gauges, snap gauges, Ring gauges and relation Gauges. Taylor's Principle of gauge design.
- 3.4 Problems of Tolerance calculations & Gauge design.

4.0 Angular Measurements

- 4.1 Concept of Angular measurement.
- 4.2 Construction & working of bevel protractor, sine bar, angle gauges, clinometer,
- 4.3 Autocollimator, angle dekkor.

5.0 Comparators

- 5.1 Principle of comparators, operation of various comparators.
- 5.2 Dial Indicators as mechanical comparator.
- 5.3 Pneumatic comparators - Solex type & highpressure dial type.
- 5.4 Electrical comparators.

5.5 Relative advantages of disadvantages of various comparators & characteristics of good comparator.

6.0 Screw Thread Measurement

6.1 Terminology of screw thread.

6.2 Measurement of various parameters of screw thread such as major diameter, minor diameter, effective diameter, pitch using instruments – bench micrometer, screw thread micrometer, floating carriage micrometer, tool makers microscope, optical profile projector.

7.0 Gear Measurement

7.1 Terminology of gear.

7.2 Measurements of chordal thickness, addendum using gear tooth vernier.

7.3 Parkinsons gear tester.

8.0 Surface Finish Measurement

8.1 Terminology

8.2 Importance of surface finish,

8.3 Concept of primary texture, secondary texture, CLA, RMS & RA Value.

8.4 Principle and operation of stylus probe instruments.

8.5 Tomlinens surface meter & Taglor – surface talysurf.

9.0 Testing Techniques

9.1 Straightness testing by straight edge & autocollimator.

9.2 Flatness testing by optical flats.

9.3 Squareness testing by dial indicators.

9.4 Parallelism testing by dial indicator and various cases of parallelism & squareness testing.

9.5 Circularity testing (Roundness testing) using dial indicator.

Learning Resources

Reference Books/ Codes of Practices

A) Books

S.No.	Author	Name of the Book	Publications
1.	R.K. Jain	Engineering Metrology	Khanna Publishers.
2.	I.C. Gupta	A text book of Engineering Metrology	Dhanpat Rai Publications, New Delhi
3.	J. Greeve and F. Wilson	Handbook of Industrial metrology	Prentice Hall Publishers, New Delhi
4.	Manish K. Kadam	Metrology and Quality Central	Everest Publishing
5.	M. Mahajan	A textbook of metrology	Dhanpat Rai & sons
6.	N. V. Raghavendra & L. Krishnamurthy	Engineering Metrology and measurements	Oxford
7.	R.K. Rajput	A Textbook of measurements & Metrology	Katson Books
8.	R.K. Rajput	Engineering Metrology and Instrumentation	Katson Books
9.	K. Duraivelu and S. Kartikeyan	Engineering Metrology and Measurement	

B) Codes of Practices

Codes of Practices by BIS IS 919 - 1963 limits, fits & tolerances IS 2029 - 1962 dial gauges IS 2984 - 1966 slip gauges etc.

List of Lab. Experiments/Demonstrations

- Use of basic precision measuring instruments such as
 - vernier caliper
 - vernier height gauge
 - vernier depth gauge
 - outside micrometer
 - inside micrometerfor measurement of actual jobs from industry such as-Bearings, Cylinder block of scooter , Connecting rod, Crank shaft, Cam shaft, Crankcase of scooter etc.
- Use of dial indicator as a mechanical comparator.
- Study and use of feeler gauge, screw pitch gauge.

TYRE MAINTENANCE & RETREADING

L T P
3 0 2

Curri. Ref. No. : AE-602

Total Contact hrs: 75

Total Marks: **125**

Theory: **100**

Lecture: 45

End Term Exam: **75**

Tutorial: 0

P.A: **25**

Practical:30

Practical: **25**

Pre-requisite:

End Term Exam: **0**

Credit: **4**

P.A: **25**

Rationale:

Tyres are required to carry the load of the vehicle at desired speeds, transfer braking efforts and withstand the thrust at varying road conditions. Thus the life of tyres are always affected by many factors, such as driving habits, loads, speeds, tyre pressure, road conditions, wheel alignment, vehicle condition, etc. On the other side, the prices of tyres are also a major investment in any automobile. Short life and tyre failures affect the life of vehicle as well as the life of passengers. Thus, as automobile person, one should have the necessary knowledge of tyre maintenance and retreading process. The retreading process helps to utilise the tyre carcass for longer life.

DETAILED COURSE CONTENTS

UNIT TOPIC/SUB-TOPIC

LECTURE Hrs

1.0 Introduction

4

- 1.1 Role of Automobile Engineer in tyre sales & service field.
- 1.2 Desirable properties & considerations in tyre design.
- 1.3 Tyre manufacturing process in brief
- 1.4 Tyre specifications & selection of tyres- section width, nominal aspect ratio, construction, rim diameter, load index, speed symbol etc.
- 1.5 Tyre material (Material for various constituents of tyre, popular materials & material for special applications).

2.0 Classification of Tyres

5

- 2.1 Conventional tubes, tubeless tyres & solid rubber tyre (Construction, comparison & application)
- 2.2 Cross ply, radial ply & belted bias (Construction, comparison, limitations & application)
- 2.3 Special application tyres viz. acquagel, dinovo, tractor, earthmoving machine and tyre for military applications (special features, construction, application & comparison with conventional tyres).
- 2.4 Tread patterns (various tread patterns, their significance, comparison & applications).

3.0 Tyre Economics

6

- 3.1 Prices of tyres for various applications in India, fluctuation in prices compared to other auto spares.
- 3.2 Running cost of tyre calculated on manufacturer's specified life of tyre, cost of tyre per km. & its contribution in overall vehicle running cost. Role of tyre maintenance in fuel efficiency.
- 3.3 Warranty/guaranty – (terms & conditions. Tyre claim settlement)

3.4 Tyre mileage recording system (Importance & information system)

3.5 Economics of tyre re-trading.

4.0 Tyre Maintenance **8**

4.1 Importance in the context of vehicle control & vehicle performance.

4.2 Scheduled maintenance

(Criteria for deciding schedule of tyre maintenance for different applications.)

4.3 Factors in scheduled maintenance

- Wheel balancing
- Wheel alignment
- Tyre rotation
- Switching & matching
- Daily maintenance such as foreign bodies removing, inflation, twin tyre damage, visual inspection etc.

4.5 Miscellaneous aspects in tyre maintenance/use.

- Tyre deterioration – aging, storage precaution for off road vehicle, effect of oil, fuel & other chemicals on tyre.

4.6 Decision for discarding or sending tyre for re-treading.

4.7 Machine, equipments & tools required for

- Tyre maintenance.
- Tyre changing & fitting machine.
- Tyre removal tools.
- Inflation garage with its calibration.

5.0 Tyre Defects & Repairs **8**

5.1 Different wear patterns

Center wear – feathered edge on tread

One side wear – outer, inner

Diagonal wear – sharp edge on sides

Hill & toe wear, Localized spot wear

(Identification & extent of type of wear, cause, remedies in vehicle & about tyre.)

5.2 Other defects in tyre

- Wheel wobble & cornering noise
- Ply separation
- Tread cracking & separation
- Foreign bodies in tyre
- Tread chipping
- Improper use of tools for removing & fitting of tyre.
- Side wall scuffing

(Identification & extent of type of wear, cause, remedies in vehicle & about type)

5.3 Tyre injuries & repair

- Nail hole repair
- Spot repair
- Reinforcement repair
- Sectional repair

6.0 Tyre Retreading **8**

6.1 What is retreading

- 6.2 Suitability of tyre for retreading
- 6.3 Types of retreading:
 Hot retreading (Tyre condition for hot retreading & comparison with cold)
 Cold retreading (Tyre condition for cold retreading & comparison with hot retreading)

- 6.4 Hot Retreading Process
- Inspection
 - Buffing
 - Cleaning (Brushing)
 - Application of cushion gum
 - Processing in tyre retreading machine
 - Inspection

- 6.5 Cold Retreading Process
- Failures in hot retreading process
 - Inspection
 - Buffing
 - Cleaning
 - Application of bounding gun
 - Preview of tread rubber
 - Bounding
 - Final Inspection
 - Retreading failure

7.0 Plant & Equipment For Tyre Retreading

6

- 7.1 General layout of tyre retreading plant

- 7.2 Machine & equipments

- Boiler
 - Hot retreading machine chamber
 - Cold retreading machine bounder
 - Buffing machine
 - Pressing dies
- (Construction, working, maintenance, capital cost and running cost)

- 7.3 Tools & gauges for retreading

(Types of tools & gauges, their use & specifications)

- 7.4 Consumables

Direct & indirect consumables required for hot & cold retreading process.

Learning Resources

Reference Books / Journals / Manuals / Codes Of Practices / Standards.

- A) Books

- | | | | |
|----|--|------------------|--|
| 1 | Kirpal singh Automotive Engineering Vol I | 7 th | / Standard publishers and distributors, New Delhi. |
| 2. | Automotive Mechanics | 10 th | Crouse & Angline/ McGraw Hills International Publication |
| 3. | Auto Mechanics- Understanding new technology | 1987 | Don Knowles/ Reston Publishers, New Jersey. |
| 5. | Automotive Handbook | 4 th | Bosch/ SAE (distributor) |

8.0 PRACTICAL

30

List of Lab Experiments/Demonstrations/ Field or Site Visits

- i) Visit to hot retreading tyre plants.
- ii) Visit to cold retreading tyre plants.
- iii) Visit to local fleet operator to observe and write down various tyre failures.
- iv) Compare constructional features and application of tube, tubeless and solid rubber tyres
- v) Compare constructional features and application of crossply, radial and belted bias tyres
- vi) Identify machines and equipment for tyre retreading and repair their technical specifications
- vii) Use and draw a neat diagram of different tools and gauges for tyre retreading
- viii) Identify and use various machines/equipment and tools required for –
 - Tyre maintenance
 - Tyre removal
 - Tyre changing
- ix) Service and repair of different types of tyres

AUTOMOBILE TRANSMISSION

L	T	P
3	0	2

Curri. Ref. No. : AE 504

Total Contact hrs.: 75

Total Marks: 150

Theory:

Theory: 45

End Term Exam: 75

Practical: 30

P.A.: 25

Pre requisite:

Practical:50

Credit: 4

End Term Exam: 25

P.A : 25

RATIONALE:

The modern automobile is made up of many systems which in turn are made up of a number of subsystems, components and innumerable parts. The systems can be grouped under four major headings viz. The Engine, The Power Train, The Chassis and the Electrics & Electronics.

The power developed by the engine of the automobile is delivered to the wheels through the Power Train. Function of the power train is not only to transmit the torque developed by the engine, but also to suitably multiply it with suitable change of rotational speeds to allow the vehicle to accelerate during starting, and also allows reverse motion of the vehicle, and differential wheel speeds during turning.

The various systems constituting the power train are of vital importance for proper movement of an automobile, and hence to be studied by every automobile engineer.

AIM:

After studying this subject, a fresh diploma engineer in Automobile Engineering should be able to explain the construction and operations, diagnose the problems and rectify them, and do necessary preventive maintenance of manually operated clutch with clutch linkages, manual transmission system, automatic transmission system, drive line assembly, differential gear box and rear axle assembly of an automobile.

THEORY: 45 Hours

UNIT	TOPIC/SUB-TOPIC	HRS.	TOTAL HRS.
1.0	INTRODUCTION Various systems of an automobile power train		1
2.0	CLUTCHES		9
	2.1 Function and requirement of clutch; types of automotive clutches: single disc and multi disc dry friction clutch, wet (oil) friction clutch, semi centrifugal clutch		
	2.2 Clutch construction; mechanical linkage for clutch operation		
	2.3 Clutch problems; clutch adjustment; clutch service operation of manually operated clutch during engagement and disengagement different components of an automotive clutch construction of automotive clutches, operation of clutch linkage different types of problems in a clutch Assembling a clutch.		
3.0	MANUAL TRANSMISSION SYSTEM		10
	3.1 Requirement of multi-speed transmission (gear box); components of a gear box; sliding mesh; synchronizer; gear shifting mechanism: Floor shift, steering column shift		
	3.2 Four speed gear box: Construction and power flow in different gears; overdrive; gear ratios		
	3.3 Transmission problems and remedies; gear oil		
4.0	AUTOMATIC TRANSMISSION SYSTEM		10
	4.1 Definition and advantages		
	4.2 Working principle and construction of a torque converter; planetary gear box- principle of operation; planetary holding units : clutches, bands, overrunning clutch; hydraulic control system		
	4.3 Common defects and remedies in automatic transmission		
UNIT	TOPIC/SUB-TOPIC	HRS.	TOTAL HRS.

5.0	DRIVE SHAFT ASSEMBLY	5
5.1	Drive (or propeller) shaft requirements; types : torque tube, Hotchkiss; universal joint; slip joint	
5.2	Troubleshooting and preventive maintenance	
6.0	REAR AXLE ASSEMBLY	7
6.1	Turning of an automobile; function of a differential; construction details of a differential	
6.2	Types of rear axle: full floating, three quarter floating, semi floating; axle shafts, bearings and housing.	
6.3	Rear axle trouble shooting, service and preventive maintenance.	
7.0	POWER TRANSMISSION SYSTEM OF MOTOR CYCLE AND SCOOTER	3
8.0	PRACTICAL	30
8.1	Removal and opening of a clutch assembly, inspect the components for wear, refit the assembly	
8.2	Drive a car to identify any of the following problems of the clutch : (i) chatter (ii) slipping (iii) drag (iv) pedal pulsation (v) pedal stiffness (vi) noise	
8.3	Check lubricant level, drain and refill lubricant in a gear box	
8.4	Disassemble a gearbox and determine gear ratios in various gears	
8.5	Disassemble and refit an universal joint	
8.6	Study the working of a differential.	

N.B.: Each student group should conduct at least five of the above or similar practical work. Each group should not exceed more than 10 students. Care should be taken to ensure that each student of the groups are actually participating in the practical work.

REFERENCE BOOKS:

1. Dr. Kirpal Singh, Automobile Engineering : Vol. I and II, Standard Publishers Distributors
2. Harbans Singh Reyat – The Automobile : S. Chand & Company Ltd.

3. William H. Crouse and Donald L. Anglin - Automotive Mechanics : Tata McGraw Hill Publishing Company Ltd., New Delhi
4. Shyam K. Agrawal - Internal combustion Engines : New Age International (P) Limited, Publishers
5. K. Newton, W. Steeols, T. K. Garrett-The Motor Vehicle : Butterworth Heinemann.
6. Joseph Heitner – Automotive Mechanics : Principles & Practices, CBS Publishers & Distributors.
7. V. A. W. Hiller & Peter Coombes, Hiller’s Fund of Motor Vehicle Tech. (Book-I)
8. Dr. Amitosh De “Automobile Engineering” Galgolia Publication, New Delhi.

AUTOMOBILE CHASSIS

L	T	P
3	0	2

Curri. Ref. No.: AE 506

Total Contact hrs.: 75

Total Marks: 125

Theory:

Theory: 45

End Term Exam: 75

Practical: 30

P.A.: 25

Pre requisite:

Practical:25

Credit: 4

End Term Exam: 0

P.A : 25

RATIONALE:

The modern automobile is made up of many systems, components and innumerable parts. Study of all these components and parts are possible by studying the various systems and understanding the role of the components and parts which make such systems. However, the systems can again be grouped under four headings viz. The Engine, The Power Train, The Chassis and The Electrics & Electronics.

The parts of an automobile under the body are referred to as Chassis. Apart from the engine and power train, several other systems are mounted on the Chassis which include the Frame work itself, suspension system through which wheels are connected to the frame, the steering arrangement by which the wheels are moved, the brake system to stop the moving car etc.

The various systems making up the chassis of an automobile are vital for operation of an automobile and hence forms an important subject for the study of automobile engineering.

AIM:

After studying this subject, a fresh diploma holder in automobile engineering should be able to understand and explain the constructional details and operations, diagnose the problems and prescribe the remedies, and undertake necessary preventive maintenance of frame work, suspension system, steering and wheel mechanism, brake system and tyres of an automobile.

THEORY: 45 Hours

UNIT	TOPIC/SUB-TOPIC	HRS.	TOTAL HRS.
1.0	FRAME WORK		3
	Function of frame; layout of frame: ladder frame, X-member frame, unitized body; constructional details of frame and frame members.		
2.0	SUSPENSION SYSTEM		12
	2.1 Functions of suspension system; different types of suspension system: rigid axle front wheel system, independent front wheel suspension system, Mcpherson strut suspension system, rigid rear suspension, independent rear suspension system; engine mounting.		
	2.2 Different Components: springs, shock absorber, torsion bar, ball joints, stabiliser.		
	2.3 Troubleshooting; preventive maintenance		
3.0	STEERING AND WHEELS		12
	3.1 Function of steering; requirements of steering system; different steering gears: rack and pinion, re-circulating ball; power steering; variable ratio steering.		
	3.2 Steering linkage; steering column		
	3.3 Wheel rim design; wheel alignment factors: Camber, caster, steering axis inclination, toe-in, turning radius.		
	3.4 Troubleshooting: tyre wear, wander or pull, brake pull, hard steering; preventive maintenance; wheel alignment.		
4.0	BRAKE SYSTEM		12
	4.1 Concept of oil hydraulics; transmission of pressure in a oil circuit.		
	4.2 Necessity and requirements of brakes; Drum brakes; disc brakes; hydraulic brake system; master cylinder and wheel cylinder; brake fluid; brake shoes and lining.		
	4.3 Power brake system; parking brakes; stop light switch		
	4.4 Troubleshooting; adjustment of brakes, master cylinder servicing; bleeding of brakes.		

5.0 TYRES

6

- 5.1 Types of tyres: solid, pneumatic with and without tube; construction and design: bias ply, radial ply, belted bias ply; tyre size and ratings; re-treading of tyres.
- 5.2 Troubleshooting: excessive wear, sway, pull, noise, vibration; preventive maintenance: inflation, tyre rotation, servicing; tyre and wheel runout; wheel balancing, tyre repair.

PRACTICAL: 30 Hours

6.0 PRACTICAL

30

Draw various vehicle chassis and its companion for two wheeler and four wheeler.

- 6.1 Replace a shock absorber from an automobile
- 6.2 Determine the stiffness of a compression coil spring
- 6.3 Find out the wheel alignment factors of a car : camber, caster, steering axis inclination and toe-in using suitable gauges
- 6.4 Open steering gear and make detailed sketch of same and label components
- 6.5 Take out the tyre and tube from rim and refit it on the rim, inflate it and fit it on the car
- 6.6 Open a master cylinder, replace all rubber parts and refit it
- 6.7 Remove a drum brake assembly from the car
- 6.8 Check a tyre and wheel assembly for static balancing.

Dismantle drum and disk brakes, identify the components and compare to each other.

Dismantle and assemble any two types of steering gear box and sketch

Observe the steering linkage and sketch

Open front axle as well as rear axle bag spring and telescopic shock absorber, observe and sketch.

N. B. : Each student group should conduct at least five of the above or similar practical work. Each group should not consist of more than 10 students. Care should be taken that each student of the groups is participating in the practical work.

REFERENCE BOOKS :

1. W. H. Course and Angline , Automotive Chasis & Body :– McGraw Hill
2. J. Webster, Auto Mechanics :– Glenco Publishing Co.
3. G. B. S. Naraug, Automobile Engineering :
4. Kirpal Singh, Automobile Engineering, Vol. I & Vol. II :. Standard Publishers and Distribution, New Delhi.
5. V. A. W. Hiller & Peter Coombes, Hiller’s Fund of Motor Vehicle Tech.
(Book-I)
6. Dr. Amitosh De “Automobile Engineering” Galgotia Publication Ltd, New Delhi.
7. K.K. Jain and R.B. Asthana Automobile Engineering, Tata Mc Graw Hill
8. T.WBirch Automotive Chassis system – Delmark Thompson Learning Inc Newyork.
9. A.K. Babu, Automotive chassis scitech Publications (India) Pvt. Ltd.
10. Devendra Vashist and Mukhtar Ahmad, Automobile Engineering, I.K. International Publishing House Pvt. Ltd.
- 11.

Automobile Machine Shop

L T P
1 0 3

Total Contact hrs.: 60

Theory: 15

Practical : 45

Pre requisite:

Credit: 3

Total Marks: 75

Curri. Ref. No.: AE 509

Theory: 0

End Term Exam: 0

P.A.: 0

Practical:75

End Term Exam: 25

P.A : 50

RATIONALE :

Modern automobile is a complex combination of systems, each designed for maximum efficiency and for compatible relationship with others. Each system must be maintained in first class operating condition, or it may affect the operation of the other related systems. Therefore, a good auto machine shop must have tools and equipment to undertake all types of fault finding and servicing jobs. The tools and equipment which are must in the auto machine shop are discussed in this subject. An Automobile engineer must have thorough knowledge and practice of all tools and equipment in an auto machine shop.

AIM :

To identify and use various tools and equipment used for maintenance and troubleshooting of automobiles.

UNIT	TOPIC/SUB-TOPIC	HRS.	TOTAL HRS.
1.0	STUDY AND USE OF THE FOLLOWING TOOLS AND EQUIPMENT Screw drivers, spanners, wrenches, pliers, hammers, chisels, files, hacksaw, drilling machine, bench vice, grinder, chain pulley block, hydraulic jack and axle stands, tools and equipment for tyres, lubrication equipment, battery testing and charging equipment, hydraulic test or service ramp, tyre remover, brake testing & equipment. High pressure washing equipment, engine analyzer, hydraulic press, piston ring compressor, ring remover, piston groove cleaner, cylinder reboring machine, cylinder honing, valve refacing machine, fuel injector tester, air compressor and pressure gauge. Piston rung squeezer.		16
2.0	MEASURING INSTRUMENTS a) Study and use of the following measuring instruments. i) Micrometer, dial gauge, vernier caliper, feeler gauge, vernier height gauge, engine compression gauge.		8

- b) Measurement of the following items and parameters
 - i) Measurement of crank pins, main journal of the crank shaft, cam shaft
 - ii) Checking alignment of connecting rod
 - iii) Measurement of the cylinder bore by inside micrometer
 - iv) Determine the ovality and taper by using dial gauge
 - v) Correct selections of pistons, piston ring groove cleaning & fitting piston rings
 - vi) Measurement of valve lift for various angles of crank rotation by using dial gauge
 - vii) Measurement of tappet clearance by using feeler gauge and setting of tappet clearance.

3.0 MACHINING OF ENGINE VALVE 12

- i) Refacing valve by valve refacing machine
- ii) Valve seat cutting (by manual and electric cutters)
- iii) Valve lapping and testing of leakage

UNIT	TOPIC/SUB-TOPIC	HRS.	TOTAL HRS.
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4.0 OPERATIONS AND INSPECTIONS 16

- i) Crank shaft grinding
- ii) Piston ring groove cleaning,
- iii) Cylinder reboring and honing
- iv) Brake drum turning (by work visit to different organisation)
- v) Turning of propeller shaft, dismantling universal joints, cleaning, reconditioning & refitting
- vi) Inspection of rear axle, differential for proper lubrication
- vii) Different types of metal bush turning, reaming & setting
- viii) Operation of CNC Lathe and Milling Machine

5.0 INSPECTION OF BRAKE SYSTEMS 8

- 5.1 Brake shoe rivetting

5.2 Adjustment and bleeding of hydraulic brakes

5.3 Adjustment of brake and clutch paddle free play

6.0 LAYOUT OF MODERN AUTO MACHINE SHOP

REFERENCE BOOKS:

1. International Labour Office, Geneva : Maintenance and Repair of Motor Vehicles.
2. Ernest Venk and Edward D. Spicer : Automotive Maintenance and Trouble shooting – D. B. Taraporevala Sons & Co. Private Limited
3. Kirpal. Singh : Automobile Engineering, Vol. I – Standard Publishers Distributors
4. Frederick E. Bricker : Audels Automobile Guide – D. B. Taraporevala Sons & Co. Private Ltd.

PROFESSIONAL PRACTICES – IV

L T P
0 0 2

Curri. Ref. No: AE 515

Total Contact hrs.: 60

Total marks: 50

Practical:25

Theory: 0

P.A : 25

Practical: 60

Credit: 1

RATIONAL

To develop general confidence, ability to communicate and attitude, in addition to basic technological concepts through Industrial visits, expert lectures, seminars on technical topics and group discussion.

AIM

Student will be able to:

- Acquire information from different sources.
- Prepare notes for given topic.
- Present given topic in a seminar.
- Interact with peers to share thoughts.
- Prepare a report on industrial visit, expert lecture

Contents

Activities

1. Industrial Visits

Structured industrial visits be arranged and report of the same shall be submitted by the individual student, to form a part of the term work.(2 visits) Following are the suggested types of Industries/ Fields –

- a. Automobile manufacturing / auto component manufacturing units to observe the working of SPM
- b. Refrigeration and air conditioning manufacturing / servicing units / industries / workshops
- c. Automobile service stations for four wheelers
- d. Co-ordinate measuring machine to observe its construction working specifications and applications.
- e. Auto Engine Testing unit to gather details regarding the testing procedures/parameters etc.
- f. Wheel Balancing unit for light and / or heavy motor vehicles.
- g. Food processing unit.
- h. Textile industry machinery manufacturing / servicing units.
- i. Hydro electric and Thermal power plants.
- j. Automotive Research Association of India, Pune, Central institute of Road Transport, Pune, Vehicle Research and Development establishment , Ahmednagar.
- k. Engine testing, exhaust gas analysis and vehicle testing
- l. PWD workshop.
- m. Safety museum at Central Labour Institute, Sion, Mumbai

The Guest Lecture/s

2. From field/industry experts, professionals to be arranged (2 Hrs duration), minimum 4 nos. from the following or alike topics. The brief report to be submitted on the guest lecture by each student as a part of Term work

- a) Electronic fuel injection systems
- b) Exhaust gas analysis.
- c) Vehicle testing.
- d) Transducer application in automobiles.
- e) Environmental pollution & control.
- f) Vehicle aerodynamics & design.
- g) Earth moving machines.
- h) Automobile pollution, norms of pollution control.
- i) Biotechnology
- j) Nanotechnology
- k) Rapid prototyping
- l) Programmable logic controllers
- m) TQM
- n) MPFI
- o) Hybrid motor vehicles
- p) Packaging technology
- q) Appropriate technology
- r) Six sigma systems
- s) LPG / CNG conversion kit.

3. Group Discussion:

The students should discuss in group of six to eight students and write a brief report on the same, as a part of term work. The topic of group discussions may be selected by the faculty members. Some of the suggested topics are (**any one**) –

- a. CNG versus LPG as a fuel.
- b. Petrol versus Diesel as a fuel for cars.
- c. Trends in automobile market.
- d. Load shading and remedial measures.
- e. Rain water harvesting.
- f. Trends in refrigeration Technology.
- g. Disaster management.
- h. Safety in day to day life.
- i. Energy Saving in Institute.
- j. Nano technology.

4. Seminar: (any 2 topics)

Seminar topic should be related to the subjects of fifth semester / topics from guest lectures. Students shall submit a report of at least 10 pages and deliver a seminar (Presentation time - 10 minutes for a group of 2 students)

5. Mini Projects: (in a group of 4-5 students)

1. Design / drawing of simple jigs, fixtures
2. Thermocouple based temperature controller.
3. Pump on / off timer
4. Models of jigs / fixtures
5. Layout design of SSI units / factory / workshop of the institute

Models of material handling route systems

OR

Modular Course on any one of the suggested or alike relevant topic be undertaken by a group of students (Min 10):

- a) LPG/CNG conversion of vehicles b) Advance features in CAD - CAM c) basics of PLC programming d) die design e) JIT techniques f) Nontraditional manufacturing methods g) jigs and fixture design h) 3D Modeling I) finite element method j) Mechatronics k) Advanced computer programming l) maintenance of home appliances m) value stream mapping n) Piping technology

Student Activities - Students in a group of 3 to 4 shall perform **ANY TWO** of the following activities (Other similar activities may be considered) and write a report as a part of term work.

Activities:-

1. Collection of data regarding loan facilities or other facilities available through different organizations / banks to budding entrepreneurs
2. Survey and interviews of successful entrepreneurs in nearby areas
3. Survey of opportunities available in thrust areas identified by Government or DIC.
4. Measuring Screw thread parameters on floating carriage dial micrometre and select the optimum diameter of wire.
5. Survey of data regarding different types of pumps with specifications from manufacturers catalogue, local markets, end users (any other engineering products may be considered for survey)
6. Survey of farm implements used by farmers

Text Books:

Name of Authors	Titles of the Book	Name of the Publisher
Mark Ratner and Daniel Ratner	Nanotechnology	Pearson Educatuion, New Delhi
YoramKorem	Computer Control of Manufacturing System	Mcgraw Hill Publication
Sunil Chopra, Peter Meindl	Supply Chain Management	Pearson Educatuion, New Delhi

AUTOMOBILE ELECTRONICS

L T P
3 0 2

Curri. Ref. No.: AE 505

Total Contact hrs. : 75

Total Marks: 150

Theory :

Theory : 45

End Term Exam : 75

Practical : 30

P.A. : 25

Pre requisite: AE 409

Practical : 50

Credit: 4

End Term Exam. : 25

P.A. : 25

RATIONALE:

Due to stringent exhaust emission regulations introduced during the early 1970's all mechanical automobiles faced an uncertain future. Engine designers were forced to adopt electronic engine control systems as a solution to their problems and so crucial early links between the automobile and electronics industries were soon formed. Subsequently, developments in microelectronics and particularly the availability of powerful low-cost microprocessors, resulted in the development of a whole host of automotive electronic systems. Most of these may be described as mechatronic systems, meaning that they integrate mechanical, electronic and microcomputer technologies. These changes, together with increasing environmental and social pressures, have led to a revolution in the concept of the automobile, and have placed great demands on those technicians involved in maintaining cars. Thus this subject is inevitable in the diploma programme.

AIM:

This subject will enable the students to understand the operation of contemporary automobile electronic systems. The topics are used to explore specific aspects of electrical electronics such as engine management and pollution control, vehicle sub-systems such as battery, starting system, ignition system, lighting system etc.

UNIT	TOPIC/SUB-TOPIC	HRS.	TOTAL HRS.
1.0	INTRODUCTION		4
	1.1 Vehicle sub-systems: Battery and charging system, Engine starting system, Lighting system, Engine management system, Chassis control systems, Body electrical system, In-car entertainment.		
	1.2 Vehicle electrical distribution system: Cable types, harness routing, cable colour coding, correctors, phasing, thermal circuit protection.		
	1.3 Multiplex wiring systems.		
2.0	DIGITAL CIRCUITS		4

- 2.1
 - a) Logic gates and its truth table
 - b) Combinational logic
 - c) Sequential circuits
 - d) Counters and Registers
- 2.2 Function of an arithmetic logic unit and memories
- 2.3
 - a) Applications of Microprocessor
 - b) DAC and ADC circuits

3.0 BATTERIES

7

- 3.1 Introduction – functions of automotive battery; types of batteries; lead acid, alkaline battery, zinc air battery
- 3.2 Lead acid battery – construction : grids, plates, case, electrolyte; chemical actions in battery; connecting cells, battery ratings, reserve capacity; ampere hour capacity, (20 minute rate), cold-cranking rate, watts; battery efficiency; ways of battery charging : constant current charging, constant voltage or potential charging, quick charging; trickle charging, overcharging and its effects
- 3.3 Battery maintenance and service – checking battery state of charge: specific gravity test, open volt test, high discharge test, cadmium test, battery troubles: self discharge, sulphation, internal short circuiting, deterioration of plates, cracking of container, corrosion of battery terminals and clamps, loss of water, cell gravity variation, discolouring of electrolyte; steps for battery maintenance: checking the battery visually, checking electrolyte level in cells in batteries with vent caps, adding distilled water in case of lower level, cleaning off corrosion around battery terminals and from top of batteries with top terminals, checking battery condition by testing of charge, charging battery if it is low.

UNIT	TOPIC/SUB-TOPIC	HRS.	TOTAL HRS.
4.0	CHARGING SYSTEM		5
	4.1 Introduction: purpose of charging system, function of alternator, principles of alternator		
	4.2 Parts of alternator: the stator, the rotor, rectifier pack; alternator regulator		
	4.3 Alternator regulation:		
5.0	IGNITION SYSTEM		5

- 5.1 Introduction - purpose of ignition system; types of ignition system: Contact breaker point, ignition system, electronic ignition system.
- 5.2 Construct and function of different parts of contact point ignition system- battery, ignition switch, ignition coil, the ignition distributor, vacuum advance mechanism spark plugs and wires and cables connecting them.
- 5.3 Servicing of contact breaker point, ignition system : causes of ignition failure, quick checks of ignition system.
- 5.4 Electric ignition system: battery, ignition coil, electronic control unit, ignition distributor, spark plugs.
- 5.5 Magneto ignition system – construction, operation.

6.0 LIGHTING SYSTEM 5

- 6.1 Construction and function of the main components of lighting system : various lamps or lights, switches, fuses and circuit breakers, junction box
- 6.2 Different types of lights : head lights, side or parking lights, tail or stop lights, dash lights, cab and body lights

UNIT	TOPIC/SUB-TOPIC	HRS.	TOTAL HRS.
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- 6.3 Parts of a lamp : bulles, reflectors, lens
- 6.4 Switches : main light switch, dipper switch, stop light switch
- 6.5 Fuses and circuit breaker
 - Describe the purpose and operation of the each component of lighting system.

7.0 MISCELLANEOUS SYSTEMS 5

- 7.1 Horn Circuit – function; main parts of horn circuit : electric horn, horn relay, switch
- 7.2 Traifficater circuit -
- 7.3 Wiper motor circuit
- 7.4 Speedometer circuit

8.0 SOME ADVANCED FEATURES OF MODERN AUTOMOBILES 5

- 8.1 Ignition system

- 8.2 Computer controlled petrol fuelling systems
- 8.3 Engine management systems (EMS)
- 8.4 Anti-lock braking system (ABS)
- 8.5 Traction control
- 8.6 Stability Control
- 8.7 Air conditioning

9.0 PRACTICAL –

30

The students should study, test and sketch constructional details

- 9.1 Battery servicing and testing
- 9.2 Inspection of ignition circuit
- 9.3 Overhauling of distributor
- 9.4 Overhauling of alternator
- 9.5 Overhauling of starter motor
- 9.6 Servicing of starting system
- 9.7 Servicing of charging system
- 9.8 Study, testing and sketching of different types of learn and relay
- 9.9 Location and identification of sensors
- 9.10 Testing of lead light learn setting by head light

REFERENCE BOOKS :

1. Dr. Kripal Singh, Automobile Engineering – Vol. I and II, Standard Publishers
2. Distributors, Delhi-6.
3. Harbans Singh Reyat, The Automobile - S. Chand & Company Ltd.
4. Joseph Heitner, Automotive Mechanics - CBS Publishers & Distributors
5. William H. Crouse, Donald L. Anglin – Automotive Mechanics - Tata McGraw Hill Publishing Company Ltd.
6. P. L. Kohli, Automotive Electrical Equipment - Tata McGraw Hill Publishing Company Ltd.
7. Eric Chowaniety, Automobile Electronics, Butterworth - Heinemann Ltd.
8. Dr. Amitosh De “Automobile Engineering” Galgotia Publication Ltd, New Delhi.

9. Barry Hollenbeck Automotive Electricity, Electronics & Computer Controls Delmar Publishers.
10. Trevor Mellard Automotive Electronic system English Language Book Society.

TERM-VI

DESIGN OF AUTO COMPONENTS

L T P
1 0 3

Curri. Ref. No. : AE-410

Total Contact hrs: 60

Total Marks: **75**

Theory:

Lecture: 15

End Term Exam:

Tutorial: 0

P.A:

Practical:45

Practical: **75**

Pre-requisite:

End Term Exam: **25**

Credit: **3**

P.A: **50**

Rationale :

In certain auto field related practices Automobile Engineer needs elementary knowledge of designing auto components, reading and interpreting the automobile related relevant drawings. This subject will help to achieve these objectives.

DETAILED COURSE CONTENTS

UNIT TOPIC/SUB-TOPIC

LECTURE Hrs

1.0 Basic Concepts Of Design

3

- 1.1 Stress and strain analysis
- 1.2 Endurance limit
- 1.3 Types of external loads and types of forces
- 1.4 Stress concentration- types, cause and remedies
- 1.5 Factor of safety
- 1.6 Selection of material and manufacturing processes
- 1.7 Use of Design data book
- 1.8 Commercial designations of materials and BIS specification
- 1.9 Standardisation

2.0 Design Consideration In Auto Component Design

3

- 2.1 Gross vehicle weight (GVW)
- 2.2 Rated Engine power
- 2.3 Rated Engine torque
- 2.4 Traction and tractive effort
- 2.5 Gradability

3.0 Design Of Frame Structure

3

- 3.1 Eccentrically loaded riveted joints – simple type of bracket connections to chassis
- 3.2 Welded joints

4.0 Design of Chassis Sub System Component

3

- 4.1 Design of clutch
- 4.2 Design of gearbox and shifting mechanism
- 4.3 Design of propeller shaft
- 4.4 Design of fully floating axle
- 4.5 Design of flanged coupling
- 4.6 Design of leaf springs

5.0 Design Of Engine Components

3

- 5.1 Engine dimensions
- 5.2 Material for engine components
- 5.3 Design of piston crown

- 5.4 Design of piston ring
- 5.5 Design of piston pin
- 5.6 Design of piston skirt
- 5.7 Design of connecting rod (CR) cross section
- 5.8 Design of CR big end cap and bolts
- 5.9 Drawing of connecting rod
- 5.10 Design of crank shaft main journal and crank pin
- 5.11 Design of components in valve actuating mechanism
- 5.12 Design of cylinder liner
- 5.13 Design of cylinder head thickness

6.0 PRACTICAL

45

Laboratory work for this subject consist of design and drawing of Auto components, preparation of four drawing sheets on engine components and four drawing sheets on chassis components by using data obtained from design calculations.

Following components can be considered for above referred work

- i) Piston
- ii) Connecting Rod
- iii) Crankshaft main journal
- iv) Crankshaft pin
- v) Various shafts of Gear Box
- vi) Clutch Plate
- vii) Coiled spring for clutch
- viii) Clutch release lever (finger)
- ix) Rear Axle full floating type
- x) Gear box
- xi) Propeller shaft

REFERENCE BOOKS:-

1. Machine Tool Design Handbook – Central Machine Tools Institute
2. Automotive Design Vol. I, II, III – Giles
3. Donkin – Motor Vehicle Design
4. Pandya & Shah – Elements of Machine Design
5. Internal combustion Engine – Maleev V.L./Mc Graw Hills International book company
6. R.H. Bacon - the car Engine and structure - Mcwillam
7. N.K. Giri - Problems in Automobile Engineering - Khanna Publication
8. K.M. Aggqrwal - Auto design problems - Satya Prakashan

VEHICLE MAINTENANCE & GARAGE PRACTICE

L T P
1 0 3

Curri. Ref. No. : AE-502

Total Contact hrs: 60 Total Marks: **100**
Lecture: 15
Tutorial: 0
Practical:45
Pre-requisite:
Credit: **3**

Theory:
End Term Exam:
P.A:
Practical: **100**
End Term Exam: **50**
P.A: **50**

Rationale

Automotive sector is growing at a very fast rate in our country. The growing population of automotive users demand efficient and effective services for repair and maintenance of vehicles. The repair and maintenance of automotive vehicles needs a variety of resources like, tools, equipment, machines as well as the right people with necessary attitudes and management abilities. This subject deals with these areas of resources for automotive sector so that the supervisors are well informed and equipped for repairs and maintenance works.

DETAILED COURSE CONTENTS

UNIT	TOPIC/SUB-TOPIC	LECTURE Hrs
	1.0 Relevant Work Profiles	2
	1.1 Final vehicle assembly supervisor	
	1.2 Engine assembly supervisor	
	1.3 Vehicle Testing supervisor	
	1.4 Rectification supervisor	
	1.5 Small to medium garage owner	
	1.6 Service engineer of an automobile company	
	1.7 State transport workshop maintenance supervisor	
	2.0 Behavioural Skills & Attitudes	2
	2.1 Behavioural skills and attitudes necessary for garage practice in various work areas.	
	2.2 Shop floor communication, Interpersonal skills	
	2.3 Application of principles of management & organization in garage practice with suitable examples.	
	3.0 Garage Layout and Management	3
	3.1 Types and layout of garages and service stations	
	3.2 Hierarchy Of Service Station - Filling station, Service station, Garages, Garage & motor, Specialised stations (Services extended and general layout)	
	4.0 Vehicle Maintenance	3
	4.1 General Machinery Maintenance & Vehicle Maintenance (Comparison)	
	4.2 Vehicle maintenance – Scheduled maintenance and breakdown maintenance.	
	4.3 Scheduled Maintenance – Pre-delivery inspection, free services from manufacturer.	

5.0 PRACTICALS

35 Hrs

Experiments / hands on practice on the following machines, with Objectives, Specification and Working of the machine:

5.1- Garage Equipment I

- i) Wheel balancing machine
- ii) Wheel alignment machine
- iii) Tyre changing machine
- iv) Engine tuning machine
- v) Carbon cleaning machine
- vi) FIP calibration machine
- vii) Compressors

5.2 Garage Equipment II

- i) PUC Diesel
- ii) PUC Petrol
- iii) Battery charger
- iv) Car washing machine
- v) Hydraulic Ramp
- vi) Brake tester
- vii) Timing light (stroboscope)
- viii) Pneumatic Grease Gun
- x) Garage Cranes
- xi) Hydraulic Jack, Floor Jack

5.3 Garage Tools - General & Special

- i) Wrenches (Fix, box, Torque, ring, tube)
- ii) Screw drivers (Phillips, flat, four, way)
- iii) Allen keys
- v) Hammer & mallets
- vi) Pullers
- vii) Engine related tools
- viii) Battery related tools
- x) Other transmission tools
- xi) Various gauges (bore gauge, Micrometers, vernier, slip gauge, filler gauge)

5.4 Denting and painting

- 4.1 Use of gas welding in denting ,
- 4.2 denting equipment and tools,
- 4.3 preparation of surface for painting ,
- 4.4 modern painting techniques used in industries such as : spray painting, powder spraying and electrostatic painting.

5.5 Visit to authorised service stations of latest vehicle manufacturer like – Maruti, Hyundai, Tata Motors etc.

5.6 To wash and serving the car using power washing machine.

5.7 Draw circuit diagram of battery charger.

5.8 Identify and draw various special tools used in engine maintenance and repairs

5.9 Identify and handle various gauges used in auto workshop

5.10 Set and operate torque wrench.

5.11 Visit to various maintenance/serving stations to study maintenance schedule

5.12 A model system for any two different types of garages.

5.13 Ratings of various service stations based on standard parameters.

Learning Resources

Reference Books/Journals/Manuals/Codes Of Practices/ Standards.

- 1 John Queenborough, Garage and service station handbook - George newness ltd, London
2. K.K. Jain & R. B. Asthana Automobile Engineering - TMH.
3. A. W. Judge Motor vehicle engine servicing - Pitman Paperback, UK
4. Car repair and maintenance - Marshall Cavendish Ltd, London.

Manuals

Sr. No.	Title	Edition	Author/ Publisher
1	Service manuals of various auto manufacturers	Latest	Respective manufacturers
2.	Service manuals of various original equipment manufacturers	t	M/s Neptune electricals, Mumbai.
3.	M/c manuals of all equipment referred under chapter 5,6,7		

PROFESSIONAL PRACTICES – V

L T P
0 0 4

Curri. Ref. No: AE 516

Total Contact hrs.: 60

Total marks: 50

Practical:

Theory: 0

P.A : 50

Practical: 60

Credit: 2

Aim:-

To develop general confidence, ability to communicate and attitude, in addition to basic technological concepts through Industrial visits, expert lectures, seminars on technical topics and group discussion.

Objective:-

Student will be able to:

- Acquire information from different sources.
- Prepare notes for given topic.
- Present given topic in a seminar.
- Interact with peers to share thoughts.
- Prepare a report on industrial visit, expert lecture.

Pre-Requisite:- Nil

Activities

1.0 Industrial Visits

Structured industrial visits be arranged and report of the same should be submitted by the individual student, to form a part of the term work.

Two industrial visits may be arranged in the following areas / industries to observe - Material Handling System, quality control charts / production record / layout flow systems / Facilities / Hydraulic & pneumatic systems / Working of Boilers and steam engineering applications.

- a. Auto / Electronic equipment manufacturing industry.
- b. Cement / Sugar / Chemical / Textile / Steel rolling mills / extrusion industries.
- c. Material handling in mines or ports.
- d. Earth Moving Equipment Maintenance Shop.

Lectures by Professional / Industrial Expert be organized from any of the following areas (four lectures of two hour duration) student shall submit the report on each lecture:

- a) Battery and its charging system
- b) Electronic ignition system
- c) Micro-processor based instrumentation in Automobiles
- d) Earth moving machines.
- e) Tractors
- f) Excavators.
- g) Fork lift truck.
- h) Road- roller.
- i) Automated Guided Vehicles (AGV)
- j) Career opportunities in Service stations, Marketing, Surveyor, Insurance, R&D, call centers, CAD, NDT, Railways, Defense, Aeronautics, Marine, Software development, Information Technology
- k) Continuing education / Open university Programs,
- l) Air compressor technology
- 2) Tribological Aspects in automobiles / machine tools

Group Discussion: (Two topics)

The students shall discuss in group of six to eight students and write a brief report on the same as a part of term work. The topic for group discussions may be selected by the faculty members. Some of the suggested topics are

- a. Solar Vehicles / Electric Vehicles.
- b. Auto Vehicles - Comparison.
- c. Two stroke versus four stroke engines
- d. Recycling of plastics and other waste material
- e. Attributes of product design
- f. Creativity and innovativeness
- g. Energy conservation in institutes
- h. Value engineering
- i. Revolution in communication technology
- j. Pneumatic tools and equipment's.

2.0 Student Activities:

The students in a group of 3 to 4 will perform ANY THREE of the following activities (other similar activities to be considered), and write a report as a part of term work.

Activity:

- a. Collecting internal communication forms.
- b. Collecting Failure data for automobile / machines / equipments.
- c. Study of Hydraulic system for any one application like - dumpers, Earth moving equipment, Auto service station.
- d. Survey of oils used for hydraulic circuits - specifications, properties, costs, manufacturers names etc.
- e. Study any one type of CNC machining center and prepare report on tooling and tool holding devices
- f. Using finite element method analyse stresses in a cantilever beam. Write all the steps involved with brief description.
- g. For a given job write a sequence of operations performed by automated manufacturing system. Draw a block diagram of control system to perform above operations
- h. Survey of types of bearings involving information about construction working principles, mounting, lubrication, materials, advantages, limitations and cost.
- i. Prepare a trouble shooting chart for any refrigeration system and suggest remedial measures to avoid failures
- j. For a drilling or milling operations on a simple machine component, draw a jig or fixtures showing various features like locating clamping, fool proofing etc.
- k. Compare non-traditional methods on the basis of working principles, accuracy, MRR, Applications and limitations
 - a) EBM b) PAM C) AJM d) WJM
- l. For a given job involving 3 to 4 operations suggest to prepare a report

3.0 Seminar:-

Seminar on any advanced technical topic to be presented by individual student in a batch of 20 students. A separate topic be selected by an individual student.

ELECTIVE COURSES

DESIGN AND FABRICATION OF AUTOMOBILES

L T P
3 0 2

Total Contact hrs.: 45

Theory: 45

Credit: 4

Total Marks: 150

Curri. Ref. No.: AE 601

Theory: 100

End Term Exam: 75

P.A.: 25

Practical: 50

End Term Exam: 25

PA: 25

RATIONALE :

Modern day automobile is far from the concept of being barely a moving contrivance consisting of a platform with seats attached, and driven by an IC engine. Today automobile is a mass produced, multi faceted mode of conveyance and mobile equipment. In the western world, it is considered to be the major mode of conveyance of the people which demands speed, comfort, style and extreme safety together.

Level of production of cars and other automobiles in many of these western countries determines their economy. In recent times, a host of modern cars have entered Indian market, and this phenomena is only going to continue in future. With the advent of these modern cars in India, it is essential that the automobile engineers are kept abreast with the latest trends in design and fabrication technologies of automobiles.

AIM :

On completion of this subject, a fresh diploma engineer shall have an idea about the latest concepts in automobile design, the various components of auto body components and their manufacturing, an overall idea about the process of assembly of automobiles in manufacturing plants. They should also be aware of various safety systems used and some of the testing done on automobiles.

UNIT	TOPIC/SUB-TOPIC	HRS.	TOTAL HRS.
1.0	MODERN DESIGN CONCEPTS		3
	Fuel economy; weight reduction keeping satisfactory rigidity; safety of car and passengers; effective utilisation of space; pollution control; electric car.		
2.0	AUTOMOBILE BODY		10
	2.1 Classification of automobiles : wheelbase size, body styles		
	2.2 Body construction : body on frame, unitised body; doors; window regulating mechanism; roof; bonnet; luggage boot; grills; door lock; two wheeler body constructional features.		

2.3 Seats and seat adjustment mechanisms; upholstery work; dash board; interior panels and fittings; wind shield; windshield wipers.

3.0 FABRICATION AND ASSEMBLY 12

3.1 Body materials : steel, aluminium, plastics and fibre glass; cold rolled steel for automotive body; pressed components; deep drawing process

3.2 Assembly line; overhead chain conveyor system; automatic welding; fitting of systems and components in the assembly line.

3.3 Body painting; spray painting; painting booth; automotive paints.

4.0 SAFETY SYSTEMS 10

4.1 Importance of safety in automobiles; safety devices: dual braking system, lights and indicators, windshield wiper with sprays, defroster, anti-theft switches, air bag.

4.2 Occupant protection: collapsible steering column, seat belt, air bag, safety glass, beams in doors/side panels, energy absorbers in bumpers.

5.0 TESTING OF AUTOMOBILES 5

Purpose of testing; laboratory tests : engine, mechanical properties of materials; meter testing and calibration; field testing : acceleration, speed, fuel consumption, braking efficiency, noise, vibration, handling, body roll at various speed and corner radii; road tests : safety, comfort, ease of maintenance; old vehicle testing for road worthiness.

6.0 ELECTRIC VEHICLE (EV) 5

6.1 Definition; advantage and disadvantages; pure electric vehicles; hybrid electric vehicles (HEV)

6.2 Constructional features of EV : battery, controller, motor

6.3 Comparison of EV and IC Engine vehicle on performance, fuel cost, pollution, application, price.

6.4 Solar cell; solar battery operated vehicle.

REFERENCE BOOKS:

1. Auto Mechanics – Theory and Service : Dekryger, Kovacik, Bono – South Western Publishing Co.
2. The Car Engine & Structure : R. H. Bacon – Macmillan
3. The Automobile : H. S. Reyat
4. Automobile Engineering : R. B. Gupta
5. Auto Mechanics: J. Webster – Glenco Publishing Co.

AUTOMOBILE RECONDITIONING

L T P
3 0 2

Curri. Ref. No.: AE 602

Total Contact hrs.: 45

Total Marks: 100

Theory:

Theory: 45

End Term Exam: 75

Practical : 30

P.A.: 25

Practical: 25

Pre requisite: AE 402

PA :25

Credit: 4

Rationale: The definition of automobile re-conditioning is to repair, restore and renew the vehicle back to pre-accident condition without the high cost and inconvenience of traditional body shop methods. In most cases, an auto-reconditioning service is performed mobile at Customer's home or office. These independent services are the fastest, most efficient and most effective methods for repairing dings, dents, bumper wheels, and minor accidents.

UNIT	TOPIC/SUB-TOPIC	TOTAL HRS.
1.	Service station tool and equipment: Machine tools and tools used in automobile repairing shop-cutters, puller, studTorque wrench , piston ring expander, piston ring cleaner	5
2.	Measuring and testing equipment: Feder gauge, cylinder bore gauge, compression gauge, igniting timing tester, spark plug tester, cam angle tester, tyre inflator gauge, micrometer and calipers.	5
3.	Vehicle service equipment: Air compressor, fuel pump, water pump, all sprayer and lubricator, light and hoists, voltage, current and resistance tester, coil condenser tester, tachometer , exhaust gas analyzer.	10
4.	Engine maintenance: Engine tuning, tuning carburettors, phasing and calibration of fuel injection pump setting, and testing of injectors, cylinder reboring ovality, taper, cylinder boring and ridge cutting , crank shaft inspection for wear and ovality crank shaft grinding Procedure effect of crank shaft and bearing wear on engine performance	13
5.	Chassis maintenance: Necessity of wheel alignment and its procedure , care of wheels and tyres,reclaiming and re trading of tyres, vulcanising , frame repairs and alignment, focusing of head lamp and maintenance of electrical accessories, adjustment of doors and locks, denting Painting, painting equipment faults in painting , chassis lubrication and lubrication chast.	12
6.	PRACTICALS:	30

Suggested list of experiments /tasks

- i) Dismantling and assembling the following types of engines – single cylinder petrol engine and diesel engine, four stroke petrol and diesel engine.

- ii) Removing the carburetor for engine and checking the components. Sketch the circuit and refit.
- iii) Removing radiator pin vehicle, checking and refitting
- iv) Removing thermostat valve, checking and refitting.
- v) Removing of fuel injectors of a petrol engine, identifying components and refitting.
- vi) Dismantling of FIP of a diesel engine, identifying its parts and assembling.
- vii) Removing fuel injectors of a diesel engine, identifying components and refitting.
- viii) Dismantling a steering gear box and calculation of its gear ratio and assembly.
- ix) Dismantling of a dry single plate clutch assembly- sketch of a clutch plate, pressure plate arrangement, clearing and reassembling.
- x) Dismantling of a multi-plate clutch used in two wheelers, study of the drive linkage and sketch of a system, clearing and reassembling.
- xi) Dismantling of a centrifugal clutch of mopeds, study of the arrangement and sketch of the system, clearing and reassembling.
- xii) Dismantling of a two/four wheeler gearbox, study of gear shifting mechanism, calculation of gear ratio sketch of gearbox, cleaning and reassembling.
- xiii) Dismantling of differential assembly, sketch the unit, clearing and reassembling.
- xiv) Dismantling of a universal joint, clearing and reassembling
- xv) Study of different types of front and rear axles and Sketches.

REFERENCE BOOKS:

1. William H. , Crouse and Donald L. Anglin – Automotive Mechanics Tata McGraw Hill Publishing company
2. James A. Johnson – Automotive diagnosis and Tuneup - McGraw Hill Book Company.
3. Jay Webster- Auto mechanics – Glencoe Publishing
4. Ken Layne – Automotive Engine performance : Tuneup, testing and service – John Wiley & Sons

RETROFITTING IN MOTOR VEHICLE

L T P
3 0 2

Curri. Ref. No.: AE 603

Total Contact hrs.: 75

Total Marks: 150

Theory: 100

Theory: 45

End Term Exam: 75

Tutorial: 0

P.A.: 25

Practical : 30

Practical: 25

Pre requisite:

PA :25

Credit: 4

Rationale:

Retrofitting in automotive is often a necessary step towards modernization and market competitive boosting Retrofitting is nothing more than the addition of new technology or feature to older system in order to improve efficiency add make functionalise be compatible with the latest environment demands.

Detailed Course Contents

UNIT	TOPIC/SUB-TOPIC	HRS.	TOTAL HRS.
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Introduction:

- | | | |
|----|---|----|
| 1. | Definition of retrofit, Diesel emission reduction strategies diesel retrofit emission Control technologies. Installation of CNG Kit in motor vehicle. Installation of LPG kit on motor vehicle. Electric and plug in electric vehicles. | 5 |
| 2. | E.V. conversion process Electric motor, motor controllers, battery chargers, wires, batteries, witches, tools, accessories, Instrumentation steps for converting to electric vehicles. | 15 |
| 3. | Electric and Hybrid Electric Drive Trains:
Basic concept of electric and hybrid traction, Introduction to various electric and hybrid Electric drive train topologies, advantages and disadvantages. | 15 |
| 4. | Regeneration Braking System (RBS):-
Introduction and need of Regenerative Braking System, Advantage and disadvantage of RBS, | 5 |

working of RBS, concept of Regeneration Braking using Piezo electric material, using shock absorbers as vibration energy non-harvesters.

5. Alternative fuels: Propane, CNG, LNG, Synthetic fuels, and conversion kits for each fuel. 5

6. Suggested list of laboratory experiments/projects 30

- i) Study of different configuration of electric vehicle, components and performance analysis.
- ii) Study of different types of batteries
- iii) Study of electric vehicle drive system
- iv) Study of auxiliary system – changing starter motor, on board power supply, lighting and environmental sensing.
- v) Repair and replacement of electric vehicle drive train
- vi) Electric conversion kits for bicycle, cycle rickshaw, scooter, car
- vii) Study of LPG gas conversion kit
- viii) Study of CNG gas conversion kit

REFERENCE BOOKS:

- 5. A.K. Babu – Electric & Hybrid Vehicles – Khanna Publishers
- 6. Jack Erjavek & Jeff Arias – Automative Fuel Technology – Electric, Hybrid and Fuel Cell Vehicles.
- 7. Iqbal Husain – Electic and Hybrid Vehicles : Design Fundamentals
- 8. Mehrdadesani, Yimingao, Ali Emadi Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals theory and Design
- 7. James D. Holderman / Hybrid and Alternative Fuel Vehicles Pearson Education.
- 8. Mark Warner The Electric Vehicle conversion Handbook : How to convert cars, truck, motor cycle, and bicycles. Includes EV components, kits and project Vehicle

RENEWABLE SOURCES OF ENERGY

L T P
3 0 2

Curri. Ref. No.: AE 604

Total Contact hrs.: 45

Total Marks: 100

Theory:

Theory: 45

End Term Exam: 75

Practical : 30

P.A.: 25

Practical: 25

Pre requisite: AE 402

PA :25

Credit: 4

RATIONALE:

Automobiles are run by burning petroleum fuel (petrol and diesel). However, burning of any fossil fuel including petroleum causes environmental pollution. Automobiles consumes the largest part of petroleum fuel and thus contributes greatly to atmospheric pollution. Moreover, another great concern is that the source of petroleum is limited, and under the present rate of usage it is possibly going to be used up in less than a century!

With this background, scientists and engineers, all over the world are frantically looking for non-conventional fuels or sources of energy, which are renewable in nature and non-polluting. A few of these non-conventional sources of energy are now seriously being tried out for powering automobiles.

It is therefore, important that the present day automobiles engineers should become acquainted with the basic knowledge of different types of non-conventional sources of energy in general, and a few particular ones which are being progressively used in the field of automobiles.

AIM:

To have a clear understanding about limitations and problems of using fossil fuel and nuclear fuel for generation of energy. Students will also be aware about the scope of various renewable sources of energy (RSE)-their advantages and disadvantages. They shall have an understanding about the technological status of each of these new sources and the challenges for making these sources useable in a large scale. Students shall also be aware of particular applications of RSE in the field of automobile.

UNIT	TOPIC/SUB-TOPIC	HRS.	TOTAL HRS.
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1.0 INTRODUCTION

5

- 1.1 Importance of energy in today's life
- 1.2 Problems of using fossil fuels:
 - i) Global Warming
 - ii) Acid Rain
 - iii) Particle Emission
 - iv) Availability

1.3	Brief description of different non-conventional sources of energy:	
	i) Solar,	
	ii) Bio-Mass,	
	iii) Wind,	
	iv) Tidal,	
	v) Geothermal,	
	vi) Fuel Cell.	
1.4	Different units of Energy and Power as used in Power-Engineering and their equivalence.	
2.0	SOLAR ENERGY	10
2.1	Advantages and disadvantages of Solar Energy.	
2.2	Solar radiation: radiation spectrum; direct and diffused radiation; density of solar radiation; solar radiation measurements.	
2.3	Solar Thermal Devices:	
	i) Liquid flat plate collectors; their construction and uses.	
	ii) Focusing type collectors and uses.	
	iii) Solar water heater, solar cooker, solar dryer, solar still.	
2.4	Thermal Energy Storage, Solar Pond.	
3.0	SOLAR PHOTOVOLTAICS	10
3.1	Basic principles of a PV cell: semiconductor and doping; p-n junction; PV effect; Silicon cells.	
3.2	Solar cell characteristics: current-voltage characteristics of a silicon PV cell, solar storage battery; efficiency.	
3.3	Applications of Photovoltaics: Remote Power, Roof-top PV Systems; PV Power Plants; Satellite Solar Power; Automobiles; Road lighting; PV lantern; water pumping.	
4.0	BIO-MASS	10
4.1	Biomass as a fuel: estimates of world biomass energy consumption; energy content of different biofuels;	
4.2	Extraction Processes: Direct burning; thermochemical processes- pyrolysis, gaisification and liquifaction.	
4.3.	Bio-chemical conversion-Biogas Anaerobic digestion: biogas plants; (digester); gasifers. Special features for biofuel engines.	
4.4	Energy from refuse: municipal solid waste; landfill gas.	
4.5	Energy crops: woody crops; agricultural wastes; ethanol from sugar cane; vegetable oils; Biodiesel.	
5.0	WIND ENERGY	4
5.1	Wind system: Earth's wind system; energy in wind.	
5.2	Wind Turbines: Horizontal and vertical axis wind turbines; aerofoil and aerodynamic forces; how a wind turbine works; major technological challenges; wind farm.	
5.3	Merit and limitations of Wind Energy.	
6.0	FUEL CELLS	6

- 6.1 Introduction to fuel cell. Advantages of fuel cell.
- 6.2 Types of fuel cells; Principles and operation of fuel cell.
- 6.3 Performance characteristics: Voltage-current density; power per cell; cell efficiency.
- 6.4 Uses of fuel cell in automobiles.
- 6.5 Hydrogen as a fuel.

7.0 PRACTICALS

REFERENCE BOOKS:

1. D.Mukherjee and S.Chakrabarti : Fundamentals of Renewable Energy Systems- New Age International Publishers.
2. S.P.Sukhatme: Solar Energy Principles of Thermal Collection and Storage- Tata McGraw Hill.
3. G.N.Tiwari and S.Suneja : Solar Thermal Engineering Systems- Narosa Publishing House
4. H.P.Garg & J.Prakash: Solar Energy- Tata McGraw Hill
5. S.Rao & B.B.Parulekar: Energy Technology –Khanna Publishers
6. G.Boyle (ed): Renewable Energy: Power for a Sustainable Future- Oxford University Press
7. Booklet on Short Course on Renewable Energy –NITTTR, Kolkata
8. Renewable Energy- Twidell & Weir, 2nd Edition
9. Renewable Energy- Sorenson.
10. D. S. Chauhan, S. K. Srivastava: Non-Conventional Energy Resources – New Age International Publishers
 - To perform experiment on solar flat plate collector used for water heating.
 - To study constructive and working of photo cell
 - To study constructive, working and maintenance of solar cooker
 - Visit to plant of solar heating system for hotel/hostel/
 - To study connection and working of horizontal axis wind mill or for visit a nearest wind farm
 - To visit a biomass/biogas plant of municipal waste or else where

PROJECT WORK

L T P
0 0 10

Curri. Ref. No. : AE-512

Total Contact hrs: Total Marks: 200
Lecture: 0
Tutorial: 0
Practical: 150
Pre-requisite:
Credit: 5

Theory: 0
End Term Exam: 0
P.A: 0
Practical: 200
End Term Exam: 100
P.A: 100

Rationale:

Project work is very important activity for the students, as it helps to develop various mental and social skills. The mental skills could be in the areas of problem formulation, gathering data, analysis and use of information, decision-making and solving problems, etc. The social skills could be in the areas of co-operation, exercising tact, communication valuing time, labour and materials, etc. The successful completion of project results in greater satisfaction and confidence levels of students. This activity has been included here keeping in view with these benefits to the students. The teacher should facilitate the students in carrying out these activities at various stages of the project, so that the students enjoy and learn by doing.

DETAILED COURSE CONTENTS

1.0 Literature Survey

- 1.1 History of Automobile.
- 1.2 Various types of roads and their conditions, Traffic density in India & in the state of Nagaland.
- 1.3 World Automobile industry (Four wheeler) – Top 15 Automobile manufactures in World, Their sales of last five years, Their models, Location of plants & collaboration, Their market (where their vehicles sold)
- 1.4 India Automobile industry two-wheeler (Moped, scooter mate, Scooter, & Motorcycle), Passenger Cars, Multi Utility Vehicles (MUV). Heavy Commercial Vehicle (HCV), Heavy Passenger motor vehicles (HPMV) & Tractors.
- 1.5 Local Manufacturers of above vehicles, their sales for last 5 years, their models & model wise sales statistics, Location & collaboration, their market, their investment & employee strength.
- 1.6 Specifications of any two vehicles from each of the following categories, two-wheeler (Moped, scooter mate, Scooter, & Motorcycle). Cars, MUV, HCV, HPMV & Tractors.

- 1.7 New arrivals & their special features from each of the following categories, 2 wheeler (Moped, scootermate, Scooter, & Motorcycle), Cars, MUV, HCV, HPMV & Tractors.
- 1.8 Prices analysis of all vehicles available in India.
- 1.9 Popular short forms used in automobile field.
- 1.10 Auto future and Auto policy in India.

2.0 Auto Ancillaries Industries in India

(Name, Location, collaboration, production process, machines, products range & OEM to Automobile Manufacturer)

- 2.1 Tyre
- 2.2 Batteries
- 2.3 Oil, Fuel and coolants.
- 2.4 Fasteners & bearings.
- 2.5 Engine components – Pistons, Piston rings, connecting rod, crankshaft, valves, gaskets, liners, pumps etc.
- 2.6 Components of Transmission subassemblies viz. Gearbox, clutch, propeller shaft, universal joints, constant velocity joints, differential, Axiles etc.
- 2.7 Steering components – Liner, pneumatic brakes, hydraulic cylinders, calliper brakes, and Antilock brake system.
- 2.8 Brake components – Linear, pneumatic brakes, hydraulic cylinders, calliper brakes, and Antilock brake system.
- 2.9 Suspension Dampers, springs, leaf springs, air suspension, hydra gas suspension.
- 2.10 Fuel systems – Fuel Pump, FIP, filters, carburettor, injectors, MPFI system etc.
- 2.11 Body Building
- 2.12 Body modification
- 2.13 LPG kit, CNG kit
- 2.14 Electrical components – starting motor, Alternator, cut-outs etc.
- 2.15 Auto comfort systems – A.C. Central locking, Power windows, Auto Seat adjustments
- 2.16 Exhaust systems – Mufflers, Catalytic converters
- 2.17 Auto security systems-Rollover protection, antitheft alarm etc.
- 2.18 Upholstery

3.0 Spares

Referring catalogue, part number, Price, Equivalent parts Original equipment manufactures (OEM) Discrimination between original & duplicate parts. (Collect catalogue, any 4 examples of equivalent-parts, discrimination of original & duplicate parts any 4 example, legislation against duplicate parts)

4.0 Garage Training

Minimum two days of training to be taken in following types of garages

- 4.1 Small Two-wheeler garage.
- 4.2 Two-wheeler authorised service station with a dealer point
- 4.3 Small Car/MUV garage.
- 4.4 Car/MUV authorised service station with a dealer point
- 4.5 Special garage
- 4.6 Tyre retreading unit

- 4.7 Auto air conditioning unit
- 4.8 A small Auto Electrical works.
- 4.9 Authorised Auto Electrical works
- 4.10 LPG/CNG retrofitting centre
- 4.11 Tractor garage
- 5.0 Project report
 - 5.1 Garage visit report
 - 5.2 Seminar presentation
 - 5.3 Case studies

Suggested Implementation Strategies

Learning by doing is a strategy suggested for this course. The teacher is supposed to act as facilitator who gives guided exercise to the students. In the garage-training phase, it is to be planned properly and well in advance, mutually by teacher and concerned garage official.

REFERENCE BOOKS:

Reference Books/Journals/ Manuals Codes of Practices/ Standards.

1. SAE Handbook - Society of Automotive Engineers
2. Overdrive – Tata Info-media Ltd., Mumbai
3. Automotive engineering - Society of Automotive Engineering, (SAE)
4. Service manuals of various auto manufacturers – Respective Manufacturers
5. Operators manual of various vehicles - Respective Manufacturers
6. Part catalogues from various auto manufactures and ancillaries

6.0 Suggested List of Experiments/Field Visits

1. Literature survey exercise using different medias namely Internet, Year books, Reference books, Magazines, Service manuals etc.
2. Structured exercises during garage training designed manually by teacher and related official of garage.
3. Project job (any one)
 - i) Prototype development of automobile component on system, steering system, brake system, transmission system etc.
 - ii) Undertaking repair, maintenance and overhandling of automobile system
 - iii) Re-conditioning of vehicles.

