

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



STUDY, EVALUATION SCHEME & SYLLABUS

For

**B. Voc
Automobile Servicing(AS)
Branch Code:102**

Based on

AICTE Model Curriculum

(EFFECTIVE FROM THE SESSION: 2019-20)

Evaluation Scheme
B. Voc Automobile Servicing

NSFQ Level 5 SEMESTER- I

S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BASV511	Motor Vehicle Technology -I	30	10	5	5	20	30		50	2
2	BASV512	Manufacturing Technology	30	10	5	5	20	30		50	2
3	BASV513	Automobile Electrical Equipment	30	10	5	5	20	30		50	2
4	BASV514	Two and Three Wheeler	30	10	5	5	20	30		50	2
5	BASP511	Mechanical Workshop Practice lab	30				20		30	50	1
6	BASP512	Basic Electricity and Electronics lab	30				20		30	50	1
7	BASP513	Language Lab	30				20		30	50	2
8	BAST511	Automotive Service Technician Level 5 (ASC/Q 1403)						Any one Training 400 hrs/ 8 weeks	150	12	
	BAST512	Spare Parts Operations Executive Level 5 (ASC/Q 1502)									
	BAST513	Industrial Engineer (Layout Design) (ASC/Q6401)									
	BAST514	Equipment Designer L5 (ASC/Q 6405)									
	BAST515	Tool Designer (ASC/Q4001)									
Total			610							500	24

NSFQ Level 5 SEMESTER- II

S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BASV521	Modern Electric & Hybrid Vehicles	30	10	5	5	20	30		50	2
2	BASV522	Motor Vehicle Technology -II	30	10	5	5	20	30		50	2
3	BASV523	Material Science and Materials	30	10	5	5	20	30		50	2
4	BASV524	Garage Organization & Transport Management	30	10	5	5	20	30		50	2
5	BASV525	Project	30				20		30	50	1
6	BASP521	Electric & Hybrid Vehicles Lab	30				20		30	50	1
7	BASP522	IT Tool Lab	30				20		30	50	2
8	BASP523	Equipment Designer L5 (ASC/Q 6405)						Any one Training (other than 1 st sem) 400 hrs/ 8 weeks	150	12	
	BAST521	Spare Parts Operations Executive Level 5 (ASC/Q 1502)									
	BAST522	Industrial Engineer (Layout Design) (ASC/Q6401)									
	BAST523	Automotive Service Technician Level 5 (ASC/Q 1403)									
	BAST524	Tool Designer (ASC/Q4001)									
Total			610							500	24

V: General Vocational; P: Vocational Practical; T: On Job Training; SSC: Sector Skill Council

NSFQ Level 6 SEMESTER- III											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BASV631	Automobile Electrical System	30	10	5	5	20	30		50	2
2	BASV632	Automobile Drawing & Design	30	10	5	5	20	30		50	2
3	BASV633	Automobile Engine Systems	30	10	5	5	20	30		50	2
4	BASV634	Auto Body Repair, Denting & Painting	30	10	5	5	20	30		50	2
5	BASH631	Uni. Human Values & ethics/Env. & Eco.	30	10	5	5	20	30		50	2
6	BASP631	Automobile Workshop - I	30				20		30	50	1
7	BASP632	Auto Body Repair, Denting & Painting Workshop	30				20		30	50	1
8	BAST631	Automotive Service Technician Level 6 (ASC/Q1404)					Any one Training 400 hrs/ 8 weeks			150	12
	BAST632	Automation Specialist (ASC/Q6807)									
	BAST633	Assembly Line Machine Setter (ASC/Q3603)									
	BAST634	Process Design Engineer (ASC/Q6404)									
Total			610							500	24

NSFQ Level 6 SEMESTER- IV											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BASV641	Automobile Engine Systems	30	10	5	5	20	30		50	2
2	BASV642	Automotive Refrigeration and Air Conditioning	30	10	5	5	20	30		50	2
3	BASV643	Vehicle Performance and Testing	30	10	5	5	20	30		50	2
4	BASV644	Electric and Hybrid Vehicles-II	30	10	5	5	20	30		50	2
5	BASH641	Env. & Eco./Uni. Human Values & ethics	30	10	5	5	20	30		50	2
6	BASP641	Automotive RAC Lab	30				20		30	50	1
7	BASP642	Vehicle Performance and Testing Lab	30				20		30	50	1
8	BAST641	Quality Controller (ASC/Q1605)					Any one Training (other than 3 rd sem) 400 hrs/ 8 weeks			150	12
	BAST642	Automation Specialist (ASC/Q6807)									
	BAST643	Assembly Line Machine Setter (ASC/Q3603)									
	BAST644	Process Design Engineer (ASC/Q6404)									
Total			610							500	24

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NSFQ Level 7 SEMESTER- V											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BASV751	Automotive System Design	30	10	5	5	20	30		50	2
2	BASV752	Alternative Fuel & Emission Control	30	10	5	5	20	30		50	2
3	BASV753	Automobile Maintenance Service & Repairs - I	30	10	5	5	20	30		50	2
4	BASV754	Auto NVH	30	10	5	5	20	30		50	2
5	BASH755	Indian Constitution / Essence of Indian Traditional Knowledge	30	10	5	5	20	30		50	2
6	BASP751	Automobile Workshop - II	30				20		30	50	1
7	BASP752	Design of Automotive Systems Lab	30				20		30	50	1
8	BAST751	Spare Parts Operations In charge (ASC/Q1503)					Any one Training 400 hrs/ 8 weeks			150	12
	BAST752	Body Shop In-Charge (ASC/Q1413)									
	BAST753	Service Supervisor (ASC/Q1412)									
	BAST754	Testing Manager (ASC/Q8405)									
Total			610							500	24

NSFQ Level 7 SEMESTER- VI											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BASV761	Automobile Maintenance Service & Repairs - II	30	10	5	5	20	30		50	2
2	BASV762	Off-road Vehicles	30	10	5	5	20	30		50	2
3	BASH763	Essence of Indian Traditional Knowledge / Indian Constitution	30	10	5	5	20	30		50	2
4	BASP761	Automobile Workshop - I	180						150	150	6
5	BAST761	Product Design Manager L7 (ASC/Q8103)					Any one Training (other than 5 th sem) 400 hrs/ 8 weeks			200	12
	BAST762	Body Shop In-Charge (ASC/Q1413)									
	BAST763	Service Supervisor (ASC/Q1412)									
	BAST764	Testing Manager (ASC/Q8405)									
Total			670							500	24

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Level 5 (Semester I)
Motor Vehicle Technology – 1

Unit1: Introduction & Chassis Layout

General study of the motor vehicle with functions of its main components and assemblies (engine excluded), Development of a Tractor and its basic function and H.P. requirements, Conventional layout of chassis Front wheel drive, four wheel drive, rear engine vehicle, their advantages and disadvantages, Layout of Maruti car chassis and tractor chassis, Definitions of items-wheel track, wheel base, front and rear overhang, kerb weight, ground clearance.

Unit2: Clutch System

Layout of conventional transmission system, Maruti car transmission system, Tractor transmission system, clutch - necessity, functions, requirements, types, Constructional details and working of single plate, multiple plate, diaphragm clutches, fluid coupling, Centrifugal and semi-centrifugal clutch, Tractor clutch, Clutch pedal free play. Torque transmitted by clutch. Simple numerical problems. Clutch defects, probable causes, remedies.

Unit3: Gear Box

Function and necessity, Construction and working details of sliding mesh, constant mesh, synchromesh gear boxes; epicyclic gear box - its applications and advantages. Over drive, Torque convertor, Maruti-800 car gear box, tractor gear box and P.T.O. shaft, 4 wheel drive auxiliary gear box. Gear ratio

Unit4: Final Drive

Torque tube drive, Hotchkiss drive, Universal joints, constant velocity joints, slip joints, Propeller shaft. Differential, slip differential, double reduction differential, final drive ratio. Tractor final drive construction and working, Rear axles-Fully floating, semi-floating, three quarter floating, Tractor axles

Unit5: Wheels and Tyres

Road-wheels - Rim types and sizes, Tyres-conventional, radial, Tubeless tyre its advantages, Tyre sizes, wheels-front and rear, Tyre retreading, Tyre wear, wheel balancing, Tyre pressure, Advantages of filling nitrogen in tyres.

Reference Books:

1. Automobile Mechanics, A.K. Babu, S.C.Sharma, T.R. Banga, Khanna Publishing House
2. Hillier's Fundamentals of Motor Vehicle Technology.A.W Hillier

Manufacturing Technology

UNIT1

(A) General Introduction: (a) Scope of subject "Workshop Technology" in engineering (b) different shop activities and broad division of the shops on the basis of nature of work done such as (i) Wooden Fabrication-carpentry (ii) Metal Fabrication (shaping and Forming, Smithy, sheet metal and Joining-welding, Riveting, Fitting and Plumbing).

GENERAL PROCESS: Classification and elementary idea of metal forming processes on the basis of the properties of deformability (Plasticity), fusibility and divisibility viz., Rolling, Forging, Drawing, Extruding, Spinning, Pressing, Punching, Blanking, Welding, Soldering, Brazing, Metal cutting processes-turning, Drilling, Boring, Shaping, Grinding, Riveting, Elementary idea of machines used for the above processes.

UNIT2

WELDING:

(a) Welding Arcs: Definition, arc initiation, arc structures, types of arc, metal transfer characteristics and influencing parameters, weld bead geometry, various types of electrodes used in various processes.

(b) Introduction to various welding processes with procedure equipment and applications such as (i) Electric arc welding and Gas welding (ii) Resistance welding. (iii) Thermit welding (iv) Carbon arc gauging. (v) Metal-Inert-Gas welding (MIG) (vi) Tungsten Inert Gas welding (TIG)

WELDING OF SPECIAL MATERIALS: (a) Welding of carbon steel, Low alloy steel and stainless steel, equipment, filler rods, weldability, procedures and precautions. (b) Welding of Grey Cast Iron (c) Welding of Aluminium (d) Welding of Plastics.

UNIT 3

Carpentry: (a) Fundamental of wood working operations (b) Common Carpentry Tools-Their classification, size, specification (name of the parts and use only): (i) Marking and measuring tools (ii) Holding and supporting tools: (iii) Cutting and Sawing Tools: (iv) Drilling and Boring Tools (v) Striking Tools-Mallet and Claw hammer (vi) Turning Tools & Equipment (vii) Miscellaneous Tools

PATTERN & MOULDING: The pattern materials used, Types of pattern allowances and pattern layout, Colour scheme patterns defects, Types of cores and their utility.

Elementary idea of patterns, green sand moulds and moulding, tools and equipment used in green sand moulding

UNIT4

Moulding and Pouring: Classification of mould materials according to characteristics, Types of sands and their importance test, parting powders and liquids, Sand mixing preparation, Moulding defects

MELTING AND POURING: Brief idea of refractory material and fluxes, Fuels and metallic materials used in foundry. Melting furnaces used in foundry such as pit furnace, Tilting and cupola furnaces,

their construction and operation, metals and alloys. Additions to molten metal, Closing and pouring of the moulds, Coring-up, venting and closing, use of ladles, spur and risers, Defects due to closing and spurring, Basic idea of fettling operations. Surface treatment, Salvaging of castings, Factors determining soundness of casting.

FOUNDRY PRACTICE: Elementary idea of special casting processes-Shell mould casting, die casing, investment mould casting, centrifugal and continuous casting full mould casting. Elementary idea of mechanisation of foundries

UNITS

POWDER METALLURGY: Introduction, principle, scope and names of processes. Production of metal powders, compaction, sintering and sizing, Self-lubricated bearings. Advantages of the process and its limitations (Elementary concept only)

TESTING OF WELDS & RELEVANT WELDING CODES: (a) Destructive methods-Tensile Test, Hardness Test, Fracture Test, Impact Test (b) Non destructive methods-visual, Liquid Penetrant Testing, Magnetic particles Testing, Radiographic Testing.

Advance Welding Process: Plasma Arc Welding, Laser Beam Welding, Electron Beam welding, Atomic Hydrogen arc welding, Stud welding, Explosion welding.

Reference Books:

1. Workshop Technology, Vol. I: BS Raghuvanshi
2. Production Technology, Vol. I: Hazra&Chaudhry

Automobile Electrical Equipment

Unit 1: Automobile Wiring Systems & Cables

Earth-return and insulated-return systems; 6 Volt, 12 Volt and 24 Volt systems Positive and negative earthing. Cables-starting systems cables, general purpose cables and hightension cables; specifications and colour codes. Diagram of a typical wiring systemWiring harness, cable connectors, circuit breakers, plastic fibre-optic wires, printed circuits Fuses in circuits.

Unit 2: Storage Battery

Principle of lead-acid cells; constructional details of battery plates, separator, container, terminal, vent plug, grouping compound. Electrolyte: specific gravity of electrolyte and its variation with temperature. Effect of charging and discharging of specific gravity, Capacity of battery Efficiency of battery, Methods of charging of battery, Internal circuit of battery charger, Care and maintenance of batteries, Checking for cell voltage and specific gravity of electrolyte, Battery tests- high discharge test, cranking motor test, open-circuit voltage test, cadmium test, life test, Battery failures, Maintenance-free batteries, VRLA batteries, Traction battery, Alkaline type batteries, Fuel cell and its types, Battery Life enhancer.

UNIT 3: Dynamo

Principle of generation of D.C. Constructional details of a Dynamo, Armature reaction, Principle of commutation, Construction of commutator. Types of wound field generator series, shunt and compound wound, Other types of D.C. generators-four brush & four pole, interlope, split field and bucking field, Dyna-Starter, Generator drive.

UNIT 4: Alternator

Principle of generation of A.C. Constructional details of an alternator, Working of alternators Advantages over dynamo, Types of alternators, Charging of battery with an alternator, Regulator for alternators.

UNIT 5: Regulators

Constant current and constant voltage systems, Double-contact and compensated voltage control regulators. Current-and-voltage regulator, Cut-out

Reference Books:

1. Automotive Electricals and Electronics, A.K. Babu, Khanna Publishing House
2. Automotive Electrical Equipment: PL Kohli
3. Modern Electrical Equipment: AW Judge
4. Automotive Electrical Equipment: WH Crouse

Two and Three Wheeler

Unit I: The Power Unit

Two stroke and four stroke SI & CI engine Construction and Working, merits and demerits, Symmetrical and unsymmetrical valve & port timing diagrams, scavenging process

Unit II: Fuel and Ignition Systems

Fuel system – Different circuits in two wheeler fuel systems, fuel injection system. Lubrication system, Ignition systems - Magneto coil and battery coil spark ignition system, Electronic ignition System, and starting system - Kick starter system – Self starter system, recent technologies

Unit III: Chassis and Sub-Systems

Main frame for two and three wheelers, its types, Chassis and different drive systems for two wheelers, Single, multiple plates and centrifugal clutches, Gear box and its and various gear controls in two wheelers. Front and rear suspension systems, Shock absorbers, Panel meters and controls on handle bar, Freewheeling devices

Unit IV: Brakes and Wheels

Drum brakes & Disc brakes Construction and Working and its Types, Front and Rear brake links layouts. Brake actuation mechanism. Spoked wheel, cast wheel, Disc wheel & its merits and demerits. Tyres and tubes Construction & its Types. Steering geometry

Unit V: Two & Three Wheelers – Case Study

Case study of Sports bike, Motor cycles, Scooters and Mopeds - Auto rickshaws, Pick up van, Delivery van and Trailer, Servicing and maintenance, recent developments.

Reference Books:

Two and three wheeler technology, dhruv u. Panchal

Mechanical Workshop Practice Lab

1. SHEET METAL WORKING AND SOLDERING:

- (EX-1) Cutting, shearing and bending of sheet.
- (EX-2) To prepare a soap case by the metal sheet
- (EX-3) To make a funnel with thin sheet and to solder the seam of the same
- (EX-4) To make a cylinder and to solder the same

2. FITTING SHOP WORK:

- (EX-1) Hack sawing and chipping of M.S. flat
- (EX-2) Filing and squaring of chipped M.S. job
- (EX-3) Filing on square of rectangular M.S. Plate

3. SMITHY SHOP WORK:

- (EX-1) To prepare square angular piece by M.S. rod
- (EX-2) To Braze M.S. flat/Tipped tool on M.S. shank
- (EX-3) To make a screw driver with metallic handle

4. Tin Smithy, Soldering, Brazing

- (EX-1) To prepare different types of joint such as lap joint single seam, double seam & cap joint-hem & wired edge.
- (EX-2) Utility article-waste paper basket or paper tray
- (EX-3) Study & sketch stakes / anvils.

5. WELDING SHOP WORK:

- (EX-1) Welding practice gas & electric
- (EX-2) Welding for lap joint after preparing the edge
- (EX-3) Welding Butt joint after preparing the edge
- (EX-4) Gas Cutting
- (EX-5) 'T' joint welding after preparation of edge.

6. Measurement of angle with the help of sin bar /Vernier Bevel protractor

7. To measure the pitch, angle and form of thread of screw.

8. To measure length, breadth, Thickness and depth height with micrometer height gauge and Vernier Calipers.

9. Calibration of Vernier Calipers/micrometersHeight gauge/depth gauge.

10. Use of feeler, wire radius and fillet gauge measurement of standard parameters.

Reference Books:

1. Workshop Technology, Vol. I: Hazra&Chaudhry
2. Elements of workshop Technology Vol. I: BS Raghuwanshi

Basic Electricity & Electronics - Lab

1. Study of series resistive circuits.
2. Study of parallel resistive circuits.
3. Study of series and parallel connection of cells in circuits.
4. Preparation of Electrolyte for lead acid battery and its charging and measurement of Specific gravity with the help of hydrometer.
5. Charging and Discharging of a capacitor.
6. Verification of magnetic field of solenoid with Iron core and Air core.
7. Verification of Torque development in a current carrying coil in magnetic field.
8. Study of R.L.C. series circuit and measurement of power and power factor.
9. Study of current and voltage measurement using Ammeter and Voltmeter.
10. Study of current and voltage measurement using Galvanometer.
11. Study of current, voltage and resistance measurement using of Multi-meter
12. Study of Power and Energy measurement using Wattmeter and Energy meter.
13. Study of working of single layer PCB manufacturing.
14. Study of working of double layer PCB manufacturing.
15. Study and interpreting circuit diagram and to check the continuity of connections.

Instrument Required:

1. Trainer kit for measuring TCR
2. Lead acid battery
3. Hydrometer
4. Trainer kit for measuring power and power factor in RLC circuits
5. Ammeter
6. Voltmeter
7. Multi-meter
8. Galvanometer
9. Energy Meter
10. PCB Manufacturing Facility

Level 5 (Semester II)
Modern Electric and Hybrid Vehicles

Unit 1:

Introduction

Introduction to electric and hybrid electric vehicles, History of hybrid and electric vehicles, Social and environmental importance of electric and hybrid electric vehicles, Electrical basics, Motor and generator basics

Unit 2:

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

Unit 3:

Power Flow

Power flow control in electric and hybrid electric drive train topologies.

Unit4:

Electric Drive Components

Introduction to electric drive components used in electric and hybrid vehicles, Electric motor requirements, Direct Current (DC) motors (Brushed and Brushless), Power converters, Drive controllers.

Unit 5:

Regenerative Braking System (RBS)

Introduction and need of Regenerative Braking System, Advantages and disadvantages of RBS, Working of RBS, Concept of Regenerative Braking using Piezoelectric material, Using shock absorbers as vibration energy harvesters.

Reference Books:

1. Electric & Hybrid Vehicles, A.K. Babu, Khanna Publishing House
2. Automotive Fuel Technology-Electric, Hybrid and Fuel-Cell Vehicles: Jack Erjavec& Jeff Arias
3. Electric and Hybrid Vehicles: Design Fundamentals: Iqbal Husain
4. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory and Design: Mehrdadsani, Yimingao, AliEmadi

Motor Vehicle Technology - II

Unit 1:

Frame and Body

Function and construction of frame, Cross-section of frames, Unitized construction (monocoque) types of bodies, Terms - Turning radius, lock-to-lock angle, centre point steering, positive steering, grade ability, Idea of Safety features in a modern car.

Unit 2:

Suspension System

Function, Types - conventional and independent, Spring types - coil, leaf - elliptical, semielliptical; helper springs, transverse springs, Spring camber; spring material, Torsion bar, stabiliser bar, Shock absorbers- telescopic and gas, Maruti suspension system and shockers. Anti-roll bars, Nitrox suspension.

Unit 3:

Steering System And Front Axle

Principle - Ackermann and Davis, Function, requirements, Steering gear box – types, Construction and working details of worm and sector, rack and pinion, worm and wheel, worm and recirculating ball type. Tractor steering, Power steering, Electronic Steering, Front axle - rigid front axle, Stub axle, Elliot and reverse Elliot type, Lemoine and reverse Lemoine type, Tractor front axle, Maruti steering system. Wheel alignment - castor angle, camber angle, K.P.I., Toe-in, toe out. General values of these.

Unit 4:

Braking System

Braking terms - braking efficiency, stopping distance, stopping time, weight transfer during braking, leading/trailing shoe of brake. Determination of braking torque, Effect of braking on steering, Types of braking systems- constructional details and working of mechanical brakes, hydraulic brakes, parking brake, vacuum, pneumatic, air-hydraulic brakes; tractor brakes, Drum and disc brakes, Master cylinder, tandem master cylinder, wheel cylinder, Brake lining and brake fluid, Brake defects, their causes and remedies, Anti Lock Braking System (ABS) & Electronic Brake Distribution (EBD).

Unit 5:

Automobile Pollution And Its Control

Effects and extent of pollution caused due to stationary and automobile engines, Harmful products and their causes in petrol & diesel engines, Measures to control exhaust emissions from two-stroke engines, four-stroke engines, and diesel engines, Turbocharger, Products which cause de-activation of catalysts in catalytic converters, Unleaded petrol, Emission measuring instruments for petrol and diesel engines. Limits specified in Motor Vehicles Act. Recent trends in Automobile Pollution Control- Exhaust Gas Recirculation, Air Injection, Reactor System, Positive Crankcase Ventilation, Evaporative Emission Control System.

Reference Books:

1. Automobile Mechanics, A.K. Babu, S.C. Sharma, T.R. Banga, Khanna Publishing House
2. Hillier's Fundamentals of Motor Vehicle Technology. A.W Hillier

Material Science & Materials

Unit 1 General:

Brief introduction to the subject and its scope in engineering field, classification of materials of industrial importance, Their chemical thermal, electrical, magnetic, mechanical and technological properties and their selection criteria for use in industry.

Structure of Metals and their Deformation:

Structure of metals and its relation to their physical, mechanical and technological properties, Elementary idea of arrangement of atoms in metals, molecular structures, crystal structures and crystal imperfections, Deformation of metals, effects of cold and hot working operations over them. Recovery re-crystallization and grain growth, solid solutions, alloys and inter metallic compounds, effect of grain size on properties of metals. PROPERTIES AND USAGE OF: (1) Metals: (a) Ferrous Metals (b) Non Ferrous Metals (2) Non-metallic Materials.

Unit 2

Metals-Ferrous Metals

(a) Classification of iron and steel. (b) Cast iron types as per I.S. - White, malleable, Grey (c) Steels: Classification of steels according to carbon content and according to use as per I.S. Mechanical properties of various steels and their uses. Availability of steel in market, Its forms and specifications (d) Alloy Steel: Effect of alloying various elements, viz Cr, Ni, Co, V, W, Mo, Si, and Mn, on mechanical properties of steel, Common alloy steels, viz, Ni-steel, Ni-Cr-steel, Tungsten steel, Cobalt steel, Stainless Steel, Tool steel - High Carbon Steel, High Speed steel, Tungsten Carbide, Silicon manganese steel, Spring Steel, Heat Resisting alloy Steels etc.

UNIT 3:

NON-METALIC MATERIALS

Introduction to Plastic and Other Synthetic Materials: Plastics- Important sources-Natural and Synthetic, Classification, thermo-set and thermoplastic, Various trade names, Important Properties and engineering use of plastics. Market forms of Plastics

Heat Insulating Materials: Classification of Heat Insulating material, properties and uses of China clay, Cork, Slag wool, Glass Wool, Thermocole, Puff, Properties and uses of asbestos as filler material. Hardware: General specification, uses and methods of storage of G.I. and C.I. steel, Copper, A.C. pressure conduits, R.C.C. spun, P.V.C. Pipes and their uses. General sheets specification (I.S.) and uses, Method of storage of G.I. sheets, M.S. sheets, General specification of pipe fitting

UNIT 4

Identification and Testing of Metal Alloys:

Selection, specification forms and availability of materials.

Heat Treatment of Metals:

Elementary concept, purpose, Iron-carbon equilibrium diagram, T.T.T. and 'S' curve in steels and its significance, Hardening, Tempering, Annealing, Normalising and case hardening

Reference Books:

1. MATERIAL SCIENCE: RS Khurmi & RS Shedha
2. Material Science and engineering V Raghavan

Garage Organization & Transport Management

Unit 1:

Layout of garage and tools & equipment required

Location of modern automobile garage, Layout of a fully equipped modern garage, Major equipment used in repair, testing, and reconditioning of automobiles, Service Station equipment (compressor, washer, hydraulic ramp and other lifting devices etc.)Denting and painting tools and equipment, Layout of fuel filling station-cum-service station.Workshop safety.

Unit 2:

Garage Procedure

A typical garage organisation chart, Duties of garage foreman, Vehicle selling- dealership, showroom, Terms of Warranty, after-sales service, advertising, and salesmanship. Diagnosing and estimating repairs. Booking of repairs, Job card, time card, Inspection and testing of repaired vehicles, Billing of repairs, Customer record, Purchase and sale of used vehicles, Insurance and accidental jobs.Safety in garages.Customersatisfaction.Time management.

Unit 3:

Store Organisation

Stores and store-keeping procedure.Day book, ledger, stock register.Indenting and issue of spares and materials.Inventorycontrol.Stocking of material - shelves, racks, bins; fuels and inflammable materials.Handling of liquids and acids.Duties and responsibilities of storekeeper and purchase officer.Tools-Storing and issuing.

Unit 4:

Fleet Management

Types of vehicles in a fleet - goods vehicles, tankers and carriers, delivery vans, fire fighting vehicles, break-down service vehicles, buses and luxury vehicles. Layout of a fleet maintenance depot, Duties of driver, conductor and mechanic, Scheduling the maintenance of a fleet. Estimating the operating cost of transport vehicles

Unit 5:

Motor Vehicle Act

Definition of vehicles, testing and certifying procedures, Registration of vehicles, Permits for passenger and goods vehicles, Licensing, Transfer of ownership. Essentials of driving and traffic regulations; signals and traffic signs

Reference Books:

1. Fleet Maintenance & Management: AW Clair
2. Motor Vehicle Act and Transport Management V.S.Khility

Project

On the basis of learning and skill acquired in the academic year, a project to be taken up by the student strengthening his/ her vocational skills

Electric and Hybrid Vehicles Lab

1. Understand working of different configurations of electric vehicles
2. Understand hybrid vehicle configuration and its components, performance analysis
3. Understand the properties of batteries and its types
4. Understand of electric vehicle drive systems.
5. Understand of hybrid electric vehicles.
6. Understand Auxiliary systems including charging, starter motor, on board power supply, lighting and environmental sensing and conducting repairs. Repair & Replacement of Electric/ Hybrid Vehicle body
7. Repair & Replacement of Electric Vehicle Drive Train
8. Fault diagnosis & repair / replacement of Battery, DC & AC Electrical Machines, Hybrid Electric Vehicles.

IT Tools Lab.

1. Spreadsheets, Word, Presentation
2. Multimedia Design
3. Troubleshooting
4. Project / Practical File
5. Viva Voce

Level 6 (SEMESTER- III)

Automobile Electrical System

UNIT 1:

Starting System

Principle, construction and working of starter motor. Series motor and its characteristics, Compound wound motor, Engine starting circuit, Starter drives-Bendix (torsion, compression), over-running clutch and sliding armature types. Starter switch - manual, solenoid, Factors affecting the starting of engines, Torque terms. Starting torque and power required, Motor efficiency, Armature reaction, typical motor specifications

UNIT 2:

Ignition System Of Spark-Ignited Engines

Types of ignition systems- battery-and-coil, magneto ignition systems, Ignition circuit, Details of the ignition system-ignition coil, distributor, condenser, contact breaker points, rotor, distributor cap, distributor drive. Firing order, Ignition timing. Ignition advance and retard, need, and factors it depends upon, Methods for obtaining advance and retard-vacuum and mechanical, Optical sensor for spark timing.

UNIT 3

Spark plugs-constructural details; types used in automobiles, conditions of working of spark plugs, Glow plugs of diesel engines. Magneto-rotating armature and rotating magnet types, Electronic ignition of cars & motor-cycles (CDI), Idea of Distributor-less Direct ignition system.

UNIT 4:

Lighting System

Requirements of automobile lighting, Head lamp - mounting and construction; Plastic headlamp Lens, sealed beam assembly, Asymmetrical head light, dipper and full beam, care of headlamp, Lens cleaners. Dynamic headlight beam control, Advanced Front lighting system (AFS) Types of bulbs. Reflector optics. Light sources – tungsten light Sources, tungsten halogen light sources, halogen infra-red reflective light sources, HID light sources (Xenon and bi-xenon), LED light sources, Blue vision head lamp. Auxillary lights, Brake light, Fog light, Flasher unit, warning lights and panel lights.

UNIT 5:

Accessories

Fuel and oil pressure gauge, cooling water temperature gauge, electrical speedometer, amperemeter, wind-screen wiper, electrical horn and relay, cigarette lighter, Odometer, wind-shield washing equipment, engine rpm meter, glow plug indicator, cluster assembly, Radio and television Interference suppressors, electrical switches. Central locking of doors, power winding of window panes, car heaters AC, blower and air flow controls, Rear defogger.

Reference Books:

1. Automotive Electricals and Electronics, A.K. Babu, Khanna Publishing House
2. Automotive Electrical Equipment: PL Kohli
3. Modern Electrical Equipment: AW Judge
4. Automotive Electrical Equipment: WH Crouse

Automobile Drawing & Design

Unit 1

Drafting of sectional views of the following assemblies: (a) Cylinder block and crankcase of 2-wheeler, (b) Poppet valve assembly of a 4-stroke engine, (c) Piston assembly, (d) Connecting rod assembly, (e) Spark plug, (f) Injector.

Unit 2

Free hand line diagram of the following systems: (a) Fuel system of petrol engine (b) Fuel system of diesel engine (c) Cooling system of a multi-cylinder engine (d) Lubricating system of a multi-cylinder engine (e) Steering system of Maruti (f) Suspension systems of Maruti (g) Hydraulic Braking System of Maruti Zen (h) Air Hydraulic Braking System of TATA (i) Block diagram of Electronic Fuel Injection (EFI) system (j) Block diagram of Common Rail Direct Injection (CRDI) system (k) Oxygen sensor (l) Fuel injector of EFI.

Unit 3

Drafting of sectional views of the following assemblies

- (1) Master cylinder
- (2) Wheel cylinder
- (3) Universal joint

Unit 4

Sketch layouts of (a) Depot (b) F.I. pump reconditioning shop (c) Electrical Workshop.

Unit 5

Design of the following components of an automobile engine

- (1) Piston assembly
- (2) Connecting rod assembly
- (3) Crank shaft
- (4) Flywheel

Reference Books:

Automobile Drawing: RB Gupta

Automobile Engine System

UNIT1

(A) Fundamentals of Thermodynamics: Internal energy, Enthalpy, Mechanical Equivalent of Heat, Conservation of energy. First and Second Law of thermodynamics P-V diagram Reversible process Various thermodynamic processes, Entropy, General case for change of entropy of a gas. Change of entropy during various processes, Temperature-entropy diagram, Simple numerical problem

(B) Air standard cycles: Otto cycle, Diesel cycle, Air standard efficiency of Otto and Diesel cycle, Effect of compression ratio on efficiency, Simple numerical problems, Graphical representation of ideal and actual cycle, Comparison between actual and ideal cycles, Reasons for variation. Mean effective pressure, Work done during the cycle.

UNIT2

(A) I.C. Engines' operation: Working of two stroke cycle and four stroke cycle petrol and diesel engines. Valve timing diagrams. Port timing diagrams, Classification of I.C. Engines.

(B) Reciprocating Engine Details: Construction, function, material and manufacturing process of: (a) Cylinder Block- 2-stroke air cooled and 4-stroke water cooled cylinder liner (wet and dry), cylinder head, gaskets, Different cylinder arrangements. Cylinder wear, Forms of combustion chamber in petrol engine Location of spark plug Combustion chamber in Diesel engines, Turbulence in Combustion chambers.

UNIT3:

Engines Details (CONTINUED)

(b) Piston-plain, split skirt, auto-thermic, cam-ground, Anodising and Tinning of piston, Piston clearance (c) Piston rings-different types (d) Piston pin; different methods of fitting piston pin (e) Valves: Poppet, Rotary, reed, Poppet Valve arrangement, Overhead and side valve operating mechanism, Valve clearance Hydraulic tappet. Sodium cooled valves. Valve seat inserts (f) Connecting rod, Section of connecting rod Bearing metal for big and small end of connecting rod (g) Crank shaft, Left hand, right hand crankshaft, Balancing of crank shaft (General idea about static and dynamic balancing, problems excluding). Main bearings, Crankshaft end play, Vibration damper. Flywheel (h) Camshaft, Camshaft drive timing gears (i) Inlet and exhaust manifold, Mufflers, Exhaust pipe (j) Variable Valve Timing (VVT).

UNIT4

(A) Rotary Engine. Principle and operation, Engine cooling, Advantages and limitations.

(B) Internal combustion Turbines. Principle of working, Classification, Brayton cycle, Cycle efficiency, Friction effect, Optimum compression ratio, Simple numerical problems, Deviation of practical cycles, Methods to improve efficiency, Turbine characteristics, combustion chamber, Fuel injection, Ignition Gas turbine Fuels, Materials, Turbine blades.

UNITS

(A) Supercharging and scavenging. Necessity of supercharging, Rotary compressors, Turbocharger requirement, Effect of supercharging on power output, mechanical losses, fuel consumption, detonation, Limitations of supercharging, Methods and classification of scavenging process, Performance of different scavenging systems.

(B) Engine specifications, specifications of engines of Indian vehicles - four wheelers, three wheelers and two wheelers.

Reference Books:

1. Automotive Engines, A.K. Babu, Khanna Publishing House
2. Thermal Engineering I & II: Sarao, Gambhir&Aggarwal
3. Automobile Engineering II: Kirpal Singh
4. Basic Automobile Engineering: CP Nakra
5. Automobile Engineering: RB Gupta

Auto Body Repair, Denting & Painting

Safety precautions and first aid, Proper use, care and maintenance of tools and equipments
Introduction on types, function of body and panels, Procedure for inspection, removing and refitting of body components panels, doors and other body parts, Arc welding-basic electricity and welding power source. Electrodes types, description and specification. arc welding procedure Gas welding-gas welding, brazing and soldering procedures Description of gas cutting, Resistance welding-resistance welding, process-spot, seam and butt welding Details of MIG welding, Method of fixation of wind screen, glass Procedure for cut open, beat out, dents, stripping of old paints, sanding at different stages, smooth surface preparation at different stages, putty application & primer application at different stages of affected area(chronological order for repair of auto body)fitment of repaired part and aligning to the original shape Personal safety – three key areas of risk eyes, skin and inhalation Details of personal protective, equipments-RPE,PPE Details of ingredients of paint, Procedure of refinishing process, Selection of consumable for doing painting work Procedure for doing painting(in chronological order),selection of materials, tools and equipments application of body filler for surface preparation, sanding on the affected area for smooth surface preparation, primer coating on the affected area, preparing affected surfaces for base coating, applying Base coat painting, clear coat painting for metallic paints, rubbing and polishing,
Application of paint production, treatment/anti rust treatment Procedure for inspection of painting, work and fixing the wind screen glass Details of spray gun-types-standard air, gap design-different sizes of nozzles, Details of different types sanding - 15 equipments Different types of sand paper-grades, Possible defects in painting, objects, causes and its cure.

Reference Books:

Automotive Body Repair & Painting Manual, John Harold Haynes

Automobile Workshop -I

UNIT 1

Engine tuning: Meaning and scope of engine tuning. Necessity of engine tuning, Service data of Maruti: Alto, WagonR, Swift (Petrol & Diesel); Hyundai: Santro, Ford: Figo; Volkswagen: Polo; Chevrolet: Spark. Engine analysis and tuning with the help of diagnostic computer, Diesel engine injection timing checking

UNIT 2

Wheel Balance: Reasons of wheel imbalance, Effect of wheel imbalance on stability of vehicle. Static and dynamic balancing, Wheel balancing by the application of weights, Wheel Alignment: Meaning of wheel alignment, Various angles-camber, caster, KPI & toe - and their effect on steering stability, General values of popular Indian vehicles, Wheel alignment on computerised wheel aligner

UNIT 3

Measurement of Exhaust Pollution by various analysers such as Four Gas Analyser, Smoke meter, Noxanalyser

UNIT 4

Use of Headlight aligner, Wheel aligner, automotive oscilloscope

UNIT 5

Servicing: Meaning and scope of servicing, Items attended to in servicing of a vehicle. Servicing a vehicle, Focussing and alignment of head lights

Reference Books:

1. Engine Service: Gary Lewis
2. Various Car's Manuals

Auto Body Repair, Denting & Painting Workshop

AUTO BODY REPAIR Practice health & safety-familiarize, select, proper use, maintain and store – tools, equipments, Consumables clothing safety Simple basic practices on computer reading, service manuals, collision repair manuals and colour matching guide, Identification of different types of body, chassis and drive lines, Identification of location of parts and panels, Practice on operating the air compressor, Practice on periodical maintenance of air compressor Inspect and decide whether it can be repaired or replaced Remove and refit body panels, doors, floors, wheel boxes and fenders Practice on removing and refitting wind shield glasses Practice on arc welding on vehicle body Practice on gas welding, gas brazing, gas soldering and gas cutting on vehicle body Practice on resistance, spot, seam and butt welding on vehicle body Practice on MIG welding Safety precautions and first aid. Proper use, care and maintenance of tools and equipments, Introduction on types, function of body and panels Procedure for inspection, removing and refitting of body components panels, doors and other body parts Arc welding-basic electricity and welding power source. Electrodes types, description and specification, Arc welding procedure Gas welding-gas welding, brazing and soldering procedures Description of gas cutting Resistance welding-resistance welding process-spot, seam and butt welding Details of MIG welding Method of fixation of wind screen glass Procedure for cut open, beat out dents, stripping of old paints, sanding at different stages, smooth surface preparation at different stages, putty application & primer application at different stages of affected area(chronological order for repair of auto body)fitment of repaired part and aligning to the

Level 6 (Semester IV) Automobile Engine Systems

UNIT 1

STARTING SYSTEM: Idea of engine starting-system circuit Kick-starting system of 2 wheelers Starting of mopeds.

IGNITION SYSTEM: Idea of Battery-and-coil ignition circuit and its working, Compression ignition of diesel engines.

LUBRICATION SYSTEM: Lubrication in 2 stroke engines - petrol and oil-injection, Lubrication in 4 stroke multi-cylinder petrol/diesel engines, Dry and wet sump lubrication, Full pressure and semi-pressure lubrication Oil pump types, Oil pump drive, relief valve; pressure gauge. Oil filters. Full-flow and by-pass type filtering systems, Crankcase dilution, crankcase ventilation Positive Crankcase Ventilation.

Properties and functions of a good lubricating oil, Additives, Gradation of lubricating oil due to viscosity.SAE numbers, Service rating, 2T and Super 2T oils for use in 2-s engines.

UNIT 2

COOLING SYSTEM: Necessity of cooling of I.C. engines, Methods of cooling-air cooling, water cooling, liquid cooling, Shape of cooling fins Field of application of air cooling.

Water cooling system - Thermo siphon system, pump system, thermostat system of cooling Thermostat - types Radiators-different types, their construction and function Pressurized cooling system; radiator pressure-cap, surge tank Cooling water temperature gauge Anti-freeze and anti-corrosive additives Coolants Flushing of cooling system.

AUTOMOBILE ENGINE FUELS: Types of fuels. Influence of structure. Calorific value Requirements in fuels for I.C. engines Properties Fuel rating, Additives for S.I. and C.I. engine fuels, Specifications of petrol and diesel Leaded and un-leaded petrol, Low Sulphur diesel Enhancing Power output- Nitrox injection.

Non-conventional fuels - LPG, CNG ethanol-mixed petrol, Properties, method of manufacture and their performance as I.C. engine fuels, Engine modifications required, Dual mode engine, Idea of Electric Vehicles and Hybrid Vehicles.

UNIT 3

FUEL SYSTEM OF DIESEL ENGINES: Fuel supply system, Filters (primary and secondary); positioning of filters, Feed pump Solid and air injection system Fuel injection pump, different types- plunger, distributor pump, their construction and working, Injectors Governors Types of governing Combustion process in diesel engine, Diesel knock, Electronically Controlled Diesel Injection Pump Common Rail Direct Injection Piezoelectric effect and its use in CRDI.

UNIT 4

FUEL SYSTEM OF PETROL ENGINES: Gravity feed system used in 2-wheelers, Fuel supply circuit of 4-wheelers.Mechanical and electrical fuel pump, Electric fuel gauge, Petrol fuel filter, Air/fuel ratio, Variation of air/fuel ratio with speed, Air cleaners (wet & dry).Cyclone filter.

CARBURETOR - Function and principle of working of simple carburetor. Carburetor controls- throttle, choke. Types of Carburetors- fixed jet carburetor (Solex type) and constant vacuum carburetors used

in YAMAHA motorcycle, Twin-barrel carburetors, Classification of carburetors, Disadvantages of carburetors Phenomenon of combustion and detonation Pre-ignition.

UNIT 5

FUEL INJECTION SYSTEMS (PETROL ENGINE): TBI, MPI; the Electronic Module, Advantages of Electronic Fuel Injection (EFI). Block diagram of the EFI, The Air Intake System and the Idle Air Control System. Fuel Delivery System. Various sensors used with the ECM, their location and purpose. Fuel Injector, Idea of Gasoline Direct Injection ENGINE PERFORMANCE AND TESTING: Various losses in an engine. Heat balance, Morse method of finding IHP, Calculation of various quantities like IHP, BHP, mechanical efficiency, thermal efficiency, relative efficiency, overall efficiency, specific fuel consumption. Performance curves.

Reference Books:

Automotive Engines, A.K. Babu, Khanna Publishing House

Automotive Refrigeration & Air-conditioning

Unit-I: Refrigeration Fundamentals: Introduction to refrigeration and vapour compression system, cycle diagram (Carnot cycle, Reverse Carnot cycle, Simple vapour compression cycle, bell Coleman cycle), effects of various operating parameters on performance of A/C System, Vapour absorption refrigeration system (No numerical), Applications of refrigeration and air conditioning.

Unit-II: Refrigerants and Air Conditioning Components: Environmental concerns/Legislation for automotive A/C systems, types and properties of refrigerants, refrigerant oils, refrigerant piping. Future refrigerants, Air conditioning components: Compressors, Condensers, flow control devices, evaporators – Design guidelines, types, sizing and their installation. Accumulators, receiver driers and desiccants, Refrigerant charge capacity determination

Unit-III: Air distribution system: Comfort conditions, Air management and heater systems, air distribution modes (Fresh/Recirculation, Face, Foot, Defrost, and Demist), A/C ducts and air filters. Blower fans, Temperature control systems (manual/semiautomatic, automatic). Vehicle operation modes and Cool-down performance

Psychrometry: Psychrometric properties, tables, charts, Psychrometric processes, Processes, Combinations and Calculations, ADP, Coil Condition line, Sensible heat factor, Bypass factor.

Unit-IV: Load analysis and control devices: Load Analysis, Outside and inside design consideration, Factors forming the load on refrigeration and air conditioning systems, Cooling and heating load calculations, Load calculations for automobiles, Effect of air conditioning load on engine performance, Air conditioning electrical and electronic control, pressure switching devices, sensors and actuators.

Unit-V: Diagnostics, Trouble Shooting, Service and Repair: Initial vehicle inspection, temperature measurements, pressure gauge reading and cycle testing, leak detection and detectors, Sight glass. Refrigerant safety/handling, refrigerant recovery; recycle and charging, system oil, system flushing, odour removal, retrofitting. Removing and replacing components, Compressor service.

Reference Books:

Refrigeration & Air Conditioning, Sadhu Singh, Khanna Publishing House

Vehicle Performance & Testing

Unit-I: Vehicle Performance Parameters: Vehicle Performance parameters: Fuel economy, acceleration, deceleration, gradability, top speed, handling, comfort, life durability, EGR systems, Impact of vehicular systems on performance: Suspension system, Steering system, Brakes, Tyres, carriage unit. Catalytic converters function and construction, Lambda close loop control system for gasoline vehicles.

Unit-II: Drive train and Component testing: Vehicular transmission performance: comparison of automotive clutches, Epicyclic transmission, torque converter, final drive and differential, testing of vehicle components: clutch, gear box (for noise and shifting force), brake testing, wheels and tyre testing – tyre wear pattern identification and causes.

Unit-III: Vehicle testing: Vehicle Testing - Road test, free acceleration test, coast down test, passer by noise test, road load data acquisition for vehicle.

Test tracks: Proving ground testing, high speed track, pavement track, corrugated track, mud track, steering pad, gradient track, deep wading through shallow water

Laboratory testing: Testing on chassis dynamometer, transition testing (Euro III onwards), accelerated testing, virtual testing, evaporative emission testing, oil consumption testing, endurance test, high speed performance test.

Collisions and Crash Testing: Crash testing: Human testing, dummies, crashworthiness, pole crash testing, rear crash testing, vehicle to vehicle impact, side impact testing, crash test sensors, sensor mounting, crash test data acquisition, braking distance test.

Unit-IV: Comfort, Convenience and Safety: Seats: types of seats, driving controls accessibility, and driver seat anthropometry. Steering: steering column angle, collapsible steering, and power steering. Adaptive cruise control, navigation system, adaptive noise control, driver information system, Safety: Motor vehicle safety standards, active safety, passive safety, bio-mechanics Structural safety, energy absorption, ergonomic consideration in safety.

Unit-V: Noise Vibration and EMI: Noise and vibration: Mechanism of noise generation, engine noise and vibration, causes and remedies on road shocks, wind noise and measurement. Automobile testing instrumentation: Sensors types and selection, instrumentation for functional tests, model test and full scale testing.

Reference Books:

Road Vehicle Performance: Methods of Measurement and Calculation, George Gordon Lucas

Electrical & Hybrid Vehicles – II

Unit -I: Hybrid Architecture and Power Plant Specifications: Series configuration locomotive drives-series parallel switching- load tracking architecture. Pre transmission parallel and combined configurations Mild hybrid- power assist- dual mode- power split- power split with shift- Continuously Variable transmission (CVT)- wheel motors. Grade and cruise targets- launching and boosting- braking and energy recuperation- drive cycle implications.

Unit -II: Sizing the Drive System and Energy Storage Technology: Matching electric drive and ICE; sizing the propulsion motor; sizing power electronics. Battery basics; lead acid battery; different types of batteries; battery parameters

Unit-III: Fuel Cells:Fuel cell characteristics- fuel cell types – alkaline fuel cell- proton exchange Membrane; direct methanol fuel cell- phosphoric acid fuel cell- molten carbonate fuel cell- solid oxide fuel cell- hydrogen storage systems- reformers- fuel cell EV- super and ultra capacitors- PEM fuel cell vehicles.

Unit IV: Energy Storage: Battery based energy storage: Battery basics, Lead acid (Pb-Acid) battery, Nickel-Cadmium (NiCd) battery, Nickel-Metal-Hydride (NiMH) battery, Lithium-ion (Li-ion) battery, Lithium-polymer (Li-poly) battery, Ultra capacitors.

Unit -V: Nonelectric Hybrid Systems: Short term storage systems flywheel accumulators, continuously variable transmissions hydraulic accumulators hydraulic pumps/motors- pneumatic hybrid engine systems operation modes.

Reference Books:

1. Electric & Hybrid Vehicles, A.K.Babu, Khanna Publishing House
2. Impacting Rapid Hydrogen Fuel Cell Electric Vehicle Commercialization David.L. Wood

Automotive RAC Lab.

1. Test on vapor compression test rig.
2. Test on air conditioning test rig.
3. Study of various methods of transport refrigeration systems.
4. Study and demonstration on car and bus air conditioning system.
5. Study of latest trends in automotive refrigeration systems.
6. Study and demonstration of controls in refrigeration.
7. Study of different components with the help of cut sections/models/charts- Compressor, Condenser, Evaporators, Expansion device, Blower fans, Hating systems etc.
8. Study of installation/operations/maintenance practices for refrigeration systems.
9. Study of leak testing and leak detection methods.
10. Visit to maintenance shop of automotive air conditioning and writing report on it.

Vehicle Performance & Testing Lab

1. Estimation of power requirement for vehicle propulsion by taking actual vehicle example.
2. Perform coast down test to find vehicle inertia.
3. On road fuel consumption test at different speeds.
4. Brake efficiency measurement
5. Pass- by noise test.
6. Free acceleration test.

7. Vibration measurement in passenger compartment
8. Laboratory testing of vehicle on chassis dynamometer for performance
9. Laboratory testing of vehicle on chassis dynamometer for emission.
10. Report based on visit to vehicle testing and research organization.
11. On road emission testing of petrol and diesel vehicles for PUC/RTO.

Level 7 (Semester V)

Automotive System Design

Unit-I:

Design of Clutches & Gearbox:

Design requirements of friction clutches, selection criterion, torque transmission capacity, lining materials, Design of single plate clutch, multi-plate clutch and centrifugal clutch. Selection of gear ratios and final drive ratio, numerical on 3- speed and 4- speed gearbox.

Unit-II:

Design of Propeller Shafts and Axles:

Design of propeller shafts for bending, torsion and rigidity, Design of universal joints and slip joints, final drive, Design of live and dead axles.

Unit-III:

Brake Systems:

Design of hydraulic braking system, internal expanding shoe brake and disc brake, design of master and wheel cylinder and piping design.

Unit-IV:

Design of Suspension and Steering System:

General design considerations of suspension system, design of helical and leaf springs for automobile suspension system, design considerations of belleville springs, elastomeric springs, design considerations of steering system and vehicle frame design.

Unit-V:

Statistical Consideration in Design and Optimization:

Ergonomics and aesthetic design, statistics in design, design for natural tolerances, statistical analysis, and mechanical reliability, introduction to design optimization of mechanical elements, adequate and optimum design, methods of optimization, johnson's method of optimum design-simple problems in optimum design like axially loaded members.

Reference Books:

1. Automotive Systems Engineering, Hermann Winner, Markus Maurer
2. Automotive Mechanics – SIEWilliam Crouse

Alternative Fuel and Emission Control

Unit-I: Conventional Fuels and Need for alternative fuels: Estimate of petroleum reserve and availability - comparative properties of fuels- diesel and gasoline, quality rating of SI and CI engine fuels, fuel additives for SI and CI engines, thermodynamics of fuel combustion - introduction to chemical thermodynamics, chemical reaction - fuels and combustion, enthalpy of formation and enthalpy of combustion, first law analysis of reacting systems, adiabatic flame temperature, need for alternative fuels, applications, types etc.

Unit-II: Alternative Fuels: Gaseous Fuels and Bio-fuel: Introduction to CNG, LPG, ethanol, vegetable oils, bio-diesel, biogas, Hydrogen and HCNG. Study of availability, manufacture, properties, storage, handling and dispensing, safety aspects, engine/vehicle modifications required and effects of design parameters performance and durability

Synthetic Fuels Introduction to Syngas, DME, P-Series, GTL, BTL, study of production, advantages, disadvantages, need, types, properties, storage and handling, dispensing and safety, discussion on air and water vehicles.

Unit-III: Emission Control (SI Engine): Emission formation in S.I. engines - Hydrocarbons, carbon monoxide, oxides of nitrogen, poly-nuclear aromatic hydrocarbon, effects of design and operating variables on emission formation in spark ignition engines, controlling of pollutant formation in engines exhaust after treatment, charcoal canister control for evaporative emission control, emissions and drivability, positive crank case ventilation system for ubhc emission reduction.

Unit-IV: Emission Measurement and Control (CI Engine):Chemical delay, intermediate compound formation, pollutant formation on incomplete combustion, effect of design and operating variables on pollutant formation, controlling of emissions, emissions and drivability, exhaust gas recirculation, exhaust after treatment – doc, dpf, scr and lnt. Measurement and test procedure (ndir analyzers, fid, chemiluminescencenox analyzer, oxygen analyzer, smoke measurement, constant volume sampling, particulate emission measurement, orsat apparatus.)

Unit-V: Health effects of Emissions from Automobiles:Emission effects on health and environment. Emission inventory, ambient air quality monitoring, Emission Norms: As per Bharat Standard up to BS– IV.

Reference Books:

1. Electric & Hybrid Vehicles, A.K. Babu, Khanna Publishing House
2. Engine Emissions: Pollutant Formation and Advances in Control Technology B.P. Pundir

Automobile Maintenance Service & Repairs – I

Unit 1:

Workshop Equipment

Equipment for testing electrical accessories: Electric test bench, growler, coil tester, ignition and cam-dwell-angle tester; wiring harness tester. Ampere-hour battery tester, voltmeter tester, Layout of diesel injector and F.I.P. reconditioning shop, Tools and equipment required

Unit 2:

Lubrication and Maintenance Schedule

Necessity for routine maintenance, Importance of service manuals, Specification of engines- petrol and diesel vehicles

- (a) Engine (b) Clutch (c) Gear Box (d) Propeller shaft (e) Universal joints (f) Differential (g) Axles and hubs

Unit 3:

Lubrication and Maintenance Schedule

- (a) Suspension system (b) Steering system (c) Tyre (d) Chassis (e) Brake-drum and disc

- (f) Battery (g) Self starter (h) Dynamo

Unit 4:

Fuel System

Maintenance Schedule of diesel engine fuel injector, hot plugs, rotary and reciprocating type of fuel injection pump, fuel injection pump of single cylinder engines, hoses & pipe lines, priming unit, tanks. Electricals: Maintenance Schedule of batteries, starter motor, dynamo, ignition system, wiper motor, electrical fuel pump, alternator, horn, flasher unit.

Unit 5:

Engine Tuning

- (a) Engine tuning of conventional and MPFI petrol engine. Adjustments of spark plug gap, valve tappet clearance, head bolts, Use of vacuum and compression gauge, Air cleaner cleaning, Ignition timing setting by timing light, Pollution checking, Troubleshooting

Reference Books:

Automobile Mechanics, A.K. Babu, S.C.Sharma, T.R. Banga, Khanna Publishing House

Automotive NVH

Unit-I:

Introduction to NVH and Vibrations:

Noise Vibration and Harshness (NVH) and its role in automotive design and development. Physiological effects of noise and vibration, sources of vibration and noise in automobiles, Basic concepts of vibration, time period, frequency, SHM, types of vibration, Natural frequency, resonance, damping, mathematical models.

Unit-II

Vibration Control and Measurement:

Different types of dampers, vibration absorbers, centrifugal pendulum, dry friction, untuned viscous, vibration isolation, Instruments, vibrometer, velocity pick-ups, frequency measurement instrument. one applications: isolation of the engine from vehicle structure and control of torsional oscillation amplitudes in engine crankshaft.

Unit-III:

Noise Fundamentals:

Fundamentals of acoustics–general sound propagation–structure borne sound and air borne sound, plane wave propagation - wave equation, specific acoustic impedance, acoustic intensity, spherical wave propagation – acoustic near and far fields, reference quantities, the decibel scale

Unit-IV:

Sound Analysis:

Anatomy of human ear, mechanism of hearing, loudness, weighting networks, equivalent sound level, relationship among sound power, sound intensity and sound pressure level.

Unit V:

Automotive Noise Sources and Control Techniques

Methods for control of engine noise, transmission noise, intake and exhaust noise, aerodynamic noise, tyre noise, brake noise.

Noise control strategy, noise control at source – along the path isolation, damping, balancing, resonators, absorption, barriers and enclosures.

Reference Books:

1. Automotive NVH Technology (Springer Briefs in Applied Sciences and Technology), **Fuchs**, Anton, **Nijman**, Eugenius, **Priebsch**, Hans-Herwig (Eds.)

Automobile Workshop - II

1. Find the mechanical efficiency of a multi-cylinder engine by Morse Test
2. Tune a multi-cylinder petrol engine and set dwell, rpm, ignition timing, CB point gap, spark plug gap, and tappet clearance.
3. Check the condition of the given battery as regards: (i) cell voltage (ii) specific gravity (iii) ampere-hour capacity (iv) Level of electrolyte. Use battery capacity tester. Clean the battery and charge it. Prepare a maintenance schedule.
4. Dismantle study, assemble and check for proper working the following: (a) Electric horn (b) Wiper motor (c) Starter motor (d) dynamo (e) alternator.
5. Test the following on electrical test bench: (a) Dynamo (b) Starter motor (c) Alternator. Also study the working of a growler.
6. Dismantle, inspect and assemble the magneto of a 2-wheeler. Set the ignition timing using dial gauge.
7. Dismantle and assemble the given electrical fuel pump. Check it for proper working.
8. Set the cut-out and regulator of a vehicle.
9. Dismantle, study, and re-assemble multi-cylinder F.I. pump.
10. Test a multi-cylinder F.I. pump on calibrating machine and check it for proper phasing. Set the injection timing on the engine.
11. Test a diesel fuel injector and set injection pressure. Grind needle and seat.
12. Study and sketch rotary F.I. pump.
13. Study of working of electric vehicle.
14. Study and sketch the Electrical Wiring System of a Car.

Design of Automotive Systems Lab

1. Design of automotive clutch assembly and component drawing using any drafting software (Two full imperial sheets along with design calculations report) consists of:
 - Functional design of clutch
 - Design of clutch shaft, hub and flange
 - Design of damper springs
 - Design of sectors, rivets etc.
 - Design of pressure plate assembly
 - Design for linkage mechanism
 - Details and assembly drawing
 - Details and assembly drawing
2. Design of automotive gear box along with reverse gear (Two full imperial sheets along with design calculationsreport) consists of:
 - Calculation of gear ratios
 - Determination of number of teeth on gear pair
 - Determination of gear reductions
 - Design of gear pairs
 - Design of shafts
 - Selection of bearings
 - Details and assembly drawing
3. Design of suspension spring and its analysis using any analysis software.

Automobile Maintenance Service & Repairs – I

Unit 1:

Workshop Equipment

Equipment for testing electrical accessories: Electric test bench, growler, coil tester, ignition and cam-dwell-angle tester; wiring harness tester. Ampere-hour battery tester, voltmeter tester, Layout of diesel injector and F.I.P. reconditioning shop, Tools and equipment required

Unit 2:

Lubrication and Maintenance Schedule

Necessity for routine maintenance, Importance of service manuals, Specification of engines- petrol and diesel vehicles (a) Engine (b) Clutch (c) Gear Box (d) Propeller shaft (e) Universal joints (f) Differential (g) Axles and hubs

Unit 3:

Lubrication and Maintenance Schedule

(a) Suspension system (b) Steering system (c) Tyre (d) Chassis (e) Brake-drum and disc (f) Battery (g) Self starter (h) Dynamo

Unit 4:

Fuel System

Maintenance Schedule of diesel engine fuel injector, hot plugs, rotary and reciprocating type of fuel injection pump, fuel injection pump of single cylinder engines, hoses & pipe lines, priming unit, tanks. Electricals: Maintenance Schedule of batteries, starter motor, dynamo, ignition system, wiper motor, electrical fuel pump, alternator, horn, flasher unit. Unit 5: Engine Tuning (a) Engine tuning of conventional and MPFI petrol engine. Adjustments of spark plug gap, valve tappet clearance, head bolts, Use of vacuum and compression gauge, Air cleaner cleaning, Ignition timing setting by timing light, Pollution checking, Troubleshooting

Reference Books:

1. Automobile Mechanics, A.K. Babu, S.C.Sharma, T.R. Banga, Khanna Publishing House
2. Automotive Technology:Service And MaintenanceDon Knowles

Off-Road Vehicles

Unit 1:

Classification and Requirements of Off Road Vehicles

Introduction, pretest, history and overview of an off-road machines, construction layout, capacity and applications, power plants, chassis and transmission, multi-axle vehicles

Unit 2:

Earth Moving Machines

Different types of earth moving equipments and their applications. Bulldozers, cable and hydraulic dozers, Crawler track, running and steering gears, scrapers, drag and self powered types - Dump trucks and dumpers - Loaders, single bucket, multi bucket and rotary types - Power and capacity of earth moving machines.

Unit 3:

Farm Equipments & Tractors

Scrapers, elevating graders, motor graders, self powered scrapers and graders, power shovel, revolving and stripper shovels, drag lines, ditchers, capacity of shovels Tractors: General description, specification and functions, light, medium and heavy wheeled tractors, crawler tracks mounted / wheeled-bull dozers, tilt dozers and angle dozers, front end loaders, factors affecting efficiency of output of tractors, simple problems, merits and demerits

Unit 4:

Combat Vehicles and Vehicle Systems

Power take off, special implements. Special features and constructional details of tankers, gun carriers and transport vehicles Vehicle Systems: Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational hydraulics, Hydro-pneumatic suspension cylinders, Power steering system, Kinematics for loader and bulldozer operational linkages, Safety features, safe warning system for dumper, Design aspects on dumper body, loader bucket and water tank of sprinkler

Unit 5:

Vehicle Evaluation Mobility

Soil-Vehicle Mechanics, characteristics of soils, nominal ground pressure, mean maximum pressure, the mobility index (mi), vehicle cone index (vci) and rated cone index (rci), mobility number, dynamic behavior and traction on wet soil, traction performance and factors affecting traction performance

Reference Books:

1. Off-road Vehicle Dynamics: Analysis, Modelling and Optimization Hamid, ArefMardani
2. Road and Off-Road Vehicle System, Manfred Ploechl
3. Off-Road Vehicles, Ian Graham

Project

On the basis of learning in the B.Voc. Programme, i.e. Level 5 to Level 7, a project to be taken up by the student strengthening his/ her vocational skills