Savitribai Phule Pune University
Faculty of Science & Technology

Curriculum

For
Bachelor of Vocational (Engg)
First Year Automobile Servicing
(Choice Based Credit System) (2020 Course)

(With Effect from Academic Year 2020-21)

1. Course Objectives

After successfully completing the vocational course, the student would have acquired relevant appropriate and adequate technical knowledge together with the professional skills and competencies in the field of Automobile Servicing so that he/she is properly equipped to take up gainful employment in this Vocation. Thus he/she should have acquired.

A. Understanding of

(a) The relevant basic concepts and principles in basic science subjects (Physics, Chemistry and Mathematics) so that the students is able to understand the different vocational subjects.
(b) The basic concepts in engineering drawing.
(c) The concepts, principles and procedures used Automobile Servicing.
(d) The knowledge of working of Automobile components.
(e) The procedure of replacing / installing Automobile Components.
(f) The concepts and principles used in Hybrid Automobiles.

B. Adequate Professional Skills and Competencies in

(a) Providing Service to the two-wheeler, three-wheeler, four-wheeler and SUVs.
(b) Testing the performance of Automobile components.
(c) Locating the fault at component level and at the stage level.
(d) Providing Service and repair to the Hybrid Automobiles.

C. A Healthy and Professional Attitude so that the student has

(a) An analytical approach while working on a job.
(b) An open mind while locating/rectifying faults.
(c) Respect for working with their own hands.
(d) Respect for honesty, punctuality and truthfulness

D. NSQF compliant skills in Qualification developed by sector skill council in Automotive sector or Capital Goods Sector pertaining to Automobile Service and Repair

2.CourseStr

ucture

The course will consist of combination of practice, theory and hands on skills in the automotive sector and Capital Goods Sector.

Curriculum

The curriculum in each of the years of the programme would be a suitable mix of general education and skill development components.

Skill Development Components:

- The focus of skill development components shall be to equip students with appropriate knowledge, practice and attitude, to become work ready. The skill development components will be relevant to the industry as per its requirements.
- The curriculum will necessarily embed within itself, National Occupational Standards (NOSs) of specific job roles within the industry. This would enable the students to meet the learning outcomes specified in the NOSs.
- The overall design of the skill development component along with the job roles selected will be such that it leads to a comprehensive specialization in few domains.
- The curriculum will focus on work-readiness skills in each of the year of training.

- Adequate attention will be given in curriculum design to practical work, on the job training, development of student portfolios and project work.

General Education Component:

- The general education component adheres to the normal senior secondary and university standards. It will emphasize and offer courses which provide holistic development. However, it will not exceed 40% of the total curriculum.
- Adequate emphasis is given to language and communication skills.

B. Voc Automobile Servicing Syllabus for First Year-

B.Voc First Year Structure for Semester-I												
Course Code	**Course Name**	**Teaching Scheme (Hrs/Wk)**		**Examination Scheme and Marks**						**Credits**		
		Th	**Pra**	**ISE**	**ESE**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**Total**
	Motor Vehicle Technology	03		50	50				100	03		03
	Automobile Electrical Equipment	03		50	50				100	03		03
	Two and Three Wheeler	03		50	50				100	03		03
	Modern Electric& Hybrid Vehicles	03		50	50				100	03		03
	Metrology and Measuring Instruments Lab		02				50	--	50		1.5	1.5
	Electric & Hybrid Vehicles Lab		02				50	--	50	--	1.5	1.5
	On Job Training		18			100			100		15	15
	Total	12	**22**	**200**	**200**	**100**	**100**		**600**	**12**	**18**	**30**

B.Voc First Year Structure for Semester-II												
Course Code	**CourseName**	**Teaching Scheme (Hours/Week)**		**Examination Scheme and Marks**						**Credits**		
		Theory	**Prac**	**ISE**	**ESE**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**Total**
	Industrial Management	03		50	50				100	03		03
	Total Quality Management	03		50	50				100	03		03
	Entrepreneurship	03		50	50				100	03		03
	Garage Organization & Transport Management	03		50	50				100	03		03
	Project		04				100	--	100		3	3
	On Job Training		18			100			100		15	15
	Total	12	**22**	**200**	**200**	**100**	**100**		**600**	**12**	**18**	**30**

*On Job Training should be carried out in any one subject per semester as per NSDC Guide lines for following Skill Sets:

1. Automotive Service Technician (ASC/ Q 1403)
2. Spare Parts Operations Executive (ASC/ Q 1502)
3. Industrial Engineer (Layout Design) (ASC/ Q6401)
4. Tool Designer (ASC/ Q4001)
5. Equipment Designer (ASC/ Q6405)

B. Voc Automobile Servicing Syllabus for Second Year

B.Voc Second Year Structure for Semester-I												
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**		**Examination Scheme and Marks**						**Credits**		
		Theory	**Pract.**	**ISE**	**ESE**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**Total**
	Automobile Electrical System	03		50	50				100	03		03
	Automobile Drawing & Design	03		50	50				100	03		03
	Automobile Engine Systems-I	03		50	50				100	03		03
	Auto Body Repair, Denting & Painting	03		50	50				100	03		03
	Automobile Workshop - I		02				50	--	50		1.5	1.5
	Auto Body Repair, Denting & Painting Workshop		02				50	--	50	--	1.5	1.5
	On Job Training*		18			100			100		15	15
	Total	**12**	**22**	**200**	**200**	**100**	**100**		**600**	**12**	**18**	**30**
B.Voc Second Year Structure for Semester-II												
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**		**Examination Scheme and Marks**						**Credits**		
		Th	**Pract.**	**ISE**	**ESE**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**Total**
	Automobile Engine Systems-II	03		50	50				100	03		03
	Automotive Refrigeration and Air Conditioning	03		50	50				100	03		03
	Vehicle Performance and Testing	03		50	50				100	03		03
	Electrical & Hybrid Vehicles – II	03		50	50				100	03		03
	Automotive RAC Lab		02				50	--	50		1.5	1.5
	Vehicle Performance and Testing Lab		02				50	--	50	--	1.5	1.5
	On Job Training		18			100			100		15	15
	Total	**12**	**22**	**200**	**200**	**100**	**100**		**600**	**12**	**18**	**30**

*On Job Training should be carried out in any one subject per semester as per NSDC Guide lines for following Skill Sets:

1. Automotive Service Technician (ASC/ Q 1404)
2. Automation Specialist (ASC/Q6807)
3. Assembly Line Machine Setter (ASC/Q3603)
4. Process Design Engineer (ASC/Q6404)
5. Quality Controller (ASC/Q1605)

B. Voc Automobile Servicing Syllabus for Third Year

B.Voc Third Year Structure for Semester-I												
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**		**Examination Scheme and Marks**						**Credits**		
		Theory	**Pract.**	**ISE**	**ESE**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**Total**
	Automotive System Design	03		50	50				100	03		03
	Alternative Fuel & Emission Control	03		50	50				100	03		03
	Automobile Maintenance Service &Repairs -I	03		50	50				100	03		03
	Auto NVH	03		50	50				100	03		03
	Automobile Workshop - II		02				50	--	50		1.5	1.5
	Design of Automotive Systems Lab		02				50	--	50	--	1.5	1.5
	On Job Training*		18			100			100		15	15
Total		**12**	**22**	**200**	**200**	**100**	**100**		**600**	**12**	**18**	**30**

B.Voc Third Year Structure for Semester-II												
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**		**Examination Scheme and Marks**						**Credits**		
		Theory	**Pract.**	**ISE**	**ESE**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**Total**
	Automobile Maintenance Service & Repairs - II	03		50	50				100	03		03
	Off-road Vehicles	03		50	50				100	03		03
	Project		08			200		100	300		9	9
	On Job Training *		18			100			100		15	15
Total		**06**	**26**	**100**	**100**	**300**		**100**	**600**	**06**	**24**	**30**

*On Job Training should be carried out in any one subject per semester as per NSDC Guide lines for following Skill Sets:

1. Spare Parts Operations Incharge (ASC/ Q 1503)
2. Body Shop In-Charge (ASC/Q1413)
3. Service Supervisor (ASC/Q1412)
4. Testing Manager (ASC/Q8405)
5. Product Design Manager L7 (ASC/Q8103)

Motor Vehicle Technology 42 Hours

UNIT 1: FRAME AND BODY & CHASSIS LAYOUT 9 Hrs

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. 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, gradeability. Idea of Safety features in a modern car.

UNIT2: DRIVE SYSTEM 9 Hrs

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. 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.

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

UNIT 2: SUSPENSION SYSTEM 8 Hrs

Function. Types - conventional and independent. Spring types - coil, leaf - elliptical, semi-elliptical; 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 8Hrs

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 8Hrs

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; tractorbrakes. 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 8Hrs

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

Automobile Electrical Equipment 42 Hours

Unit 1: Automobile Wiring Systems & Cables 8 Hrs

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 high- tension cables; specifications and colour codes. Diagram of a typical wiring system. Wiring harness, cable connectors, circuit breakers, plastic fibre-optic wires, printed circuits. Fuses incircuits.

Unit 2: Storage Battery 9 Hrs

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 Lifeenhancer.

UNIT 3: Dynamo 8 Hrs

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, interpole, split field and bucking field. Dyna-Starter, Generator drive.

UNIT 4: AC Circuits and Alternator 9 Hrs

Generation of A.C. voltage, its generation and wave shape. Cycle, frequency, peak value R.M.S. value, form factor, crest factor, Phase difference, power and power factor, A.C. Series Circuits with (i) resistance and inductance (ii) resistance and capacitance and (iii) resistance inductance and capacitance, Q factor of R.L.C. series circuits. 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 8 Hrs

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 PublishingHouse
2. Automotive Electrical Equipment: P L Kohli
3. Modern Electrical Equipment: A W Judge
4. Automotive Electrical Equipment: W H Crouse

Two and Three Wheeler 42 Hours

Unit I: The Power Unit 8 Hrs
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 9 Hrs
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, Starting system - Kick starter system – Self starter system, Recent technologies

Unit III: Chassis and Sub-Systems 9 Hrs
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 8 Hrs
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 8 Hrs
Case study of Sports bike, Motor cycles, Scooters and Mopeds - Auto rickshaws, Pick up van, Delivery van and Trailer, Servicing and maintenance, recent developments

Modern Electric and Hybrid Vehicles 42 Hours

Unit 1: Introduction 9 Hrs
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 8 Hrs
Basic concept of electric and hybrid traction, Introduction to various electric and hybrid electric drive train topologies, Advantages and disadvantages

Unit 3: Power Flow 8 Hrs

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

Unit4: Electric Drive Components 8 Hrs

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) 9 Hrs

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 PublishingHouse
2. Automotive Fuel Technology-Electric, Hybrid and Fuel-Cell Vehicles: Jack Erjavec & Jeff Arias
3. Electric and Hybrid Vehicles: Design Fundamentals: IqbalHusain
4. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory and Design: Mehrdadehsani, Yimingao, AliEmadi

Metrology and Measuring Instruments lab.

1. Measurement of angle with the help of sine bar/ Vernier Bevelprotractor.
2. Study and sketch of various types of opticalprojectors.
3. Study and sketch of various types of comparators and use them for comparing length of given piece.
4. To measure the diameter of a hole with the help of precisionballs.
5. To measure external and internal taper with the help of taper gauges, precisionrollers.
6. To test the squareness of a component withauto-collimeter.
7. To measure the pitch, angle and form of thread of ascrew.
8. To measure the geometry of a gear having involuteprofile.
9. To measure the straightness of the edge of a component with the help of auto-collimeter.
10. To measure the length, breadth, thickness, depth, height withmicrometer.
11. To measure the length, breadth, thickness, depth, height, with height gauge and Vernier calipers.
12. Calibration of Verniercalipers/micrometers.
13. Calibration of height gauge/depthgauge.
14. Study of a tool maker'smicroscope.
15. Checking of accuracy of snap gauge with slopgauge.
16. Checking of accuracy of a plug gauge withmicrometer.
17. Measurement of areas by polarplanimeter.
18. Use of feeler, wire, radius and fillet gauges measurement of standardparameters.

Electric and Hybrid Vehicles Lab

1. Understand working of different configurations of electricvehicles
2. Understand hybrid vehicle configuration and its components, performanceanalysis
3. Understand the properties of batteries and itstypes
4. Understand of electric vehicle drivesystems.
5. Understand of hybrid electricvehicles.
6. Understand Auxiliary systems including charging, starter motor, on board power supply, lighting and environmental sensing and conducting repairs. Repair & Replacement of Electric/ Hybrid Vehiclebody
7. Repair & Replacement of Electric Vehicle DriveTrain
8. Fault diagnosis & repair / replacement of Battery, DC & AC Electrical Machines, Hybrid ElectricVehicles

(Semester II)

Industrial Management 42 Hours

1. Introduction: **9 Hrs**

Growth of industry, The management of men, materials and machines, the art of management, Sources of capital- industrial individual enterprise, private partnership and private Ltd. Co., Joint Stock Co. shares, debentures, financial agencies and their role in promoting industries. Break even analysis.

2. Private sector and public sector: **8 Hrs**

Public sector enterprise, merits and demerits of public sector industry and private sector industry, Line, staff and functional organizations, reasons for the choice of various types of organization, functions of different departments, viz. stores, purchase and sales departments relationship between individual departments.

3. Wages &incentives: **8 Hrs**

Definition of wages, real wage and nominal wage, systems of wage payment, incentives, financial and non - financial incentives, Essentials of a good wage plan, essentials of a good incentive scheme. Introduction to elements of cost & indirect expenses, Material cost, labour cost, fixed and variable overheads, components of cost, selling price, Factory expenses, administrative expenses, selling & distribution expenses, depreciation, obsolescence, interest on capital, Idleness, Repair and maintenance.

4. Labour, industrial & tax laws: **9 Hrs**

Evolution of industrial law, factory act, workmen compensation act, payment of wages act, employee's state insurance act, Industrial dispute act. Role of technician in industry: Position of technician in various engineering departments, Role of a supervisor in industry, Foremanship, duties and qualities of a good foreman.

5. Materialmanagement: **8 Hrs**

Introduction, Scope of Material Management selective control techniques-ABC analysis, Material handling, inventory control, Essential steps in inventory control, quality standards

Reference Books:

1.Industrial Management, S.C. Sharma, Khanna Publishing House

Total Quality Management 42 Hours

1. Introduction, Basic concepts of total quality management. **9 Hrs**

Introduction to Quality, Dimensions of Quality, Quality Planning, Concept and definition of quality cost, Determinants of Quality, Optimum cost of performance, Principles of TQM, Pillars of TQM, Introduction to leadership and Leadership roles, Quality council and Quality statement, Strategic Planning Process, Deming philosophy

2. Continuous process improvement. **9 Hrs**

Input /output process Model, Juran trilogy, PDCA Cycle, 5 –'S' Housekeeping principle, Kaizen Seven tools of Quality (Q-7 tools), Check Sheet, Histogram, Cause and effect diagram, Pereto diagram, Stratification analysis, Scatter diagram, Control charts, Control chart for variables & process capability, Control chart for attributes.

3. Management planning tools & Benchmarking. **8 Hrs**

Affinity diagram, Relationship diagram, Tree diagram, Matrix diagram, Matrix data analysis, Arrow Diagram, Process decision programme chart (PDPC), Concept of bench marking, Reason to bench marking, Bench marking process, Types of bench marking, Benefits of bench marking

4. Just in time(JIT). **8 Hrs**

JIT philosophy, Three elements of JIT, Principles of JIT Manufacturing, JIT Manufacturing building blocks, JIT benefits, Kanban & 2 Bin Systems.

5. Total productive maintenance (TPM) **8 Hrs**

Concept of Total Productive Maintenance, Types of maintenance, OEE (Overall Equipment Efficiency), Stages in TPM implementation, Pillars of TPM, Difficulties faced in TPM implementation.

Reference Books:

1.Total Quality Management, S.C. Sharma, M.P. Poonia, Khanna Publishing House

Entrepreneurship 42 Hours

1. Entrepreneurship and entrepreneur: **9 Hrs**

Need of Employment and Opportunities, Essential Characteristics of a good Entrepreneur, Industrial Policy, Classification of industries- Micro, small scale , Medium scale, Large scale, Type of industries- Production, Job based & Service.

2. Entrepreneurial Development: **8 Hrs**

Product identification/ selection, Site selection, Plant layout, Institutional support needed, Pre-market survey.

3. Entrepreneurship Support System and Start-ups: **9 Hrs**

Introduction to start-up's, Role of District Industries Centre in setting up industry, Function of NSIC, SISI, NISIET, NRDC, SSIC, SIDO, NMTC, KVIC, RSMML, Role of state finance corporation, state electricity corporations, pollution control board, BIS, I.S.O. etc.

4. Introduction to Tax System, Insurance and Acts: **8 Hrs**

Idea of income tax, sales tax, excise duty and custom duty, Industrial and fire insurance, procedure for industrial insurance, Introduction to Industrial acts, factory act, Workmen's compensation act 1923, Apprentices act 1961, Environmental protection act 1986.

5. Project Report Preparation: 8 Hrs

Procedure of preparing a project report, Format of project report, Preparation of project report, Introduction to ISO: 9000 Series of Quality System

Garage Organization & Transport Management 42 Hours

Unit 1: Layout Of Garage And Tools & Equipment Required 9 Hrs

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 9 Hrs

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. Customer satisfaction. Time management.

UNIT 3: STORE ORGANISATION 8 Hrs

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

UNIT 4: FLEET MANAGEMENT 8 Hrs

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 8 Hrs

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 trafficsigns

Reference Books:

1. Fleet Maintenance & Management: AW Clair

Project

On the basis of learning in the vocational diploma, a project to be taken up by the student strengthening his/ her vocational skills

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(b) The basic concepts in engineering drawing.
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D. NSQF compliant skills in Qualification developed by sector skill council in Automotive sector or Capital Goods Sector pertaining to Automobile Service and Repair

2.CourseStructure

The course will consist of combination of practice, theory and hands on skills in the automotive sector and Capital Goods Sector.

Curriculum
The curriculum in each of the years of the programme would be a suitable mix of general education and skill development components.

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components will be relevant to the industry as per its requirements.

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B. Voc Automobile Servicing Technology Syllabus for Second Year

B.Voc Second Year Structure for Semester-I												
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**		**Examination Scheme and Marks**						**Credits**		
		Theory	**Pract.**	**ISE**	**ESE**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**Total**
	Automobile Electrical System	03		50	50				100	03		03
	Automobile Drawing & Design	03		50	50				100	03		03
	Automobile Engine Systems-I	03		50	50				100	03		03
	Auto Body Repair, Denting & Painting	03		50	50				100	03		03
	Automobile Workshop - I		02				50	--	50		1.5	1.5
	Auto Body Repair, Denting & Painting Workshop		02				50	--	50	--	1.5	1.5
	On Job Training*		18			100			100		15	15
	Total	**12**	**22**	**200**	**200**	**100**	**100**		**600**	**12**	**18**	**30**

B.Voc Second Year Structure for Semester-II												
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**		**Examination Scheme and Marks**						**Credits**		
		Th	**Pract.**	**ISE**	**ESE**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**Total**
	Automobile Engine Systems-II	03		50	50				100	03		03
	Automotive Refrigeration and Air Conditioning	03		50	50				100	03		03
	Vehicle Performance and Testing	03		50	50				100	03		03
	Electrical & Hybrid Vehicles – II	03		50	50				100	03		03
	Automotive RAC Lab		02				50	--	50		1.5	1.5
	Vehicle Performance and Testing Lab		02				50	--	50	--	1.5	1.5
100	On Job Training		18			100			100		15	15
	Total	**12**	**22**	**200**	**200**	**100**	**100**		**600**	**12**	**18**	**30**

Semester 3 (2nd Year)

AUTOMOBILE ELECTRICAL SYSTEM 42 Hours

UNIT 1: STARTING SYSTEM 9 Hrs

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 9 Hrs

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 INGNITION SYSTEM 8 Hrs

Spark plugs-constructional 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 8 Hrs

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 8 Hrs

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.

Suggested Reading:
Automotive Electrical Equipment: PL Kohli
Modern Electrical Equipment: AW Judge
Automotive Electrical Equipment: WH Crouse

AUTOMOBILE DRAWING & DESIGN 42 Hours

Unit1 **8 Hrs**

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 **9 Hrs**

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 **8 Hrs**

Drafting of sectional views of the following assemblies
(1) Master cylinder (2) Wheel cylinder (3) Universal joint

Unit 4 **8 Hrs**

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

Unit 5 **9 Hrs**

Design of the following components of an automobile engine
(1) Piston assembly (2) Connecting rod assembly (3) Crank shaft (4) Flywheel

Suggested Readings:
Automobile Drawing: RB Gupta

AUTOMOBILE ENGINE SYSTEMS – I 42 Hours

UNIT1 **8 Hrs**

(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 **8 Hrs**

(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. Automobile Servicing

UNIT3: Engines Details (continued) 8 Hrs

(a) Piston-plain, split skirt, auto-thermic, cam-ground, Anodising and Tinning of piston, Piston clearance (b) Piston rings-different types (c) Piston pin; different methods of fitting piston pin (d) Valves: Poppet, Rotary, reed, Poppet Valve arrangement, Overhead and side valve operating mechanism. Valve clearance. Hydraulic tappet. Sodium cooled valves. Valve seat inserts (e) Connecting rod, Section of connecting rod. Bearing metal for big and small end of connecting rod (f) 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 (g) Camshaft, Camshaft drive timing gears (h) Inlet and exhaust manifold, Mufflers, Exhaust pipe (i) Variable Valve Timing (VVT).

UNIT. 4 8 Hrs

(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.

UNIT. 5 8 Hrs

(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 42 Hours

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

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, Nox analyser

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

Suggested Reading:
Engine Service: Gary Lewis
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 original shape, Practice on plasma welding, Practice on minor repair of auto body cut open, beat out, strip out old paint, make smooth surface by using different grades of sanders, apply putty on affected area and applying primer(repair damaged body which is ready for final paint) Apply base coat painting, Fit check the repaired components for alignment

AUTO BODY PAINTING Practice health & safety-familiarize, select, proper use, maintain and store – tools, equipments, Consumables clothing safety, Practice on removing paint from the damaged area Practice on mixing and applying body filler Practice on sanding (block) Practice on mixing and applying putty Practice on applying primer Practice on feather edge sanding and masking Base coat application Surface cleaning and degreasing Second and third coat application Preheating the vehicle and cooling Cutting, scuffing, rubbing and polishing

Semester 4 (2nd Year)

AUTOMOBILE ENGINE SYSTEMS- II 42 Hours

UNIT 1 **9 Hrs**

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 - petroil 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 **9 Hrs**

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 - Thermosiphon 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 **8 Hrs**

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 **8 Hrs**

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 **8 Hrs**

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.

Automotive Refrigeration and Air Conditioning 42 Hours

Unit-I: Refrigeration Fundamentals: **8 Hrs**

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: **9 Hrs**

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: **8 Hrs**

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

Unit-IV: Load analysis and control devices: **9 Hrs**

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: **8 Hrs**

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.

Vehicle Performance & Testing 42 Hours

Unit-I: Vehicle Performance Parameters: 9 Hrs

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: 8 Hrs

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: 9 Hrs

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: 8 Hrs

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: 8 Hrs

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.

Electrical & Hybrid Vehicles – II 42 Hours

Unit -I: Hybrid Architecture and Power Plant Specifications: 9 Hrs

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: 8 Hrs

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: 9 Hrs

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: 8 Hrs

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: 8 Hrs

Short term storage systems flywheel accumulators. Continuously variable transmissions hydraulic accumulator's hydraulic pumps/motors- pneumatic hybrid engine systems operation modes.

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

Savitribai Phule Pune University

Faculty of Science & Technology

Curriculum

For

Bachelor of Vocational (Engg)

Third Year Automobile Servicing
(Choice Based Credit System) (2020 Course)

(With Effect from Academic Year 2020-21)

1. Course Objectives

After successfully completing the vocational course, the student would have acquired relevant appropriate and adequate technical knowledge together with the professional skills and competencies in the field of Automobile Servicing so that he/she is properly equipped to take up gainful employment in this Vocation. Thus he/she should have acquired.

A. Understanding of

(a) The relevant basic concepts and principles in basic science subjects (Physics, Chemistry and Mathematics) so that the students is able to understand the different vocational subjects.
(b) The basic concepts in engineering drawing.
(c) The concepts, principles and procedures used Automobile Servicing.
(d) The knowledge of working of Automobile components.
(e) The procedure of replacing / installing Automobile Components.
(f) The concepts and principles used in Hybrid Automobiles.

B. Adequate Professional Skills and Competencies in

(a) Providing Service to the two-wheeler, three-wheeler, four-wheeler and SUVs.
(b) Testing the performance of Automobile components.
(c) Locating the fault at component level and at the stage level.
(d) Providing Service and repair to the Hybrid Automobiles.

C. A Healthy and Professional Attitude so that the student has

(a) An analytical approach while working on a job.
(b) An open mind while locating/rectifying faults.
(c) Respect for working with their own hands.
(d) Respect for honesty, punctuality and truthfulness

D. NSQF compliant skills in Qualification developed by sector skill council in automotive sector or Capital Goods Sector pertaining to Automobile service and repair

2. Course Structure

The course will consist of combination of practice, theory and hands on skills in the automotive sector and Capital Goods Sector.

Curriculum

The curriculum in each of the years of the programme would be a suitable mix of general education and skill development components.

Skill Development Components:

- The focus of skill development components shall be to equip students with appropriate knowledge, practice and attitude, to become work ready. The skill development components will be relevant to the industry as per its requirements.
- The curriculum will necessarily embed within itself, National Occupational Standards (NOSs) of specific job roles within the industry. This would enable the students to meet the learning outcomes specified in the NOSs.
- The overall design of the skill development component along with the job roles selected will be such that it leads to a comprehensive specialization in few domains.
- The curriculum will focus on work-readiness skills in each of the year of training.

- Adequate attention will be given in curriculum design to practical work, on the job training, development of student portfolios and project work.

General Education Component:

- The general education component adheres to the normal senior secondary and university standards. It will emphasize and offer courses which provide holistic development. However, it will not exceed 40% of the total curriculum.
- Adequate emphasis is given to language and communication skills.

B. Voc Automobile Servicing Syllabus for Third Year.

B.Voc Third Year Structure for Semester-I												
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**		**Examination Scheme and Marks**						**Credits**		
		Theory	**Pract.**	**ISE**	**ESE**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**Total**
	Automotive System Design	03		50	50				100	03		03
	Alternative Fuel & Emission Control	03		50	50				100	03		03
	Automobile Maintenance Service &Repairs -I	03		50	50				100	03		03
	Auto NVH	03		50	50				100	03		03
	Automobile Workshop - II		02				50	--	50		1.5	1.5
	Design of Automotive Systems Lab		02				50	--	50	--	1.5	1.5
	On Job Training*		18			100			100		15	15
Total		**12**	**22**	**200**	**200**	**100**	**100**		**600**	**12**	**18**	**30**

B.Voc Third Year Structure for Semester-II												
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**		**Examination Scheme and Marks**						**Credits**		
		Theory	**Pract.**	**ISE**	**ESE**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**Total**
	Automobile Maintenance Service & Repairs - II	03		50	50				100	03		03
	Off-road Vehicles	03		50	50				100	03		03
	Project		08			200		100	300		9	9
	On Job Training *		18			100			100		15	15
Total		**06**	**26**	**100**	**100**	**300**		**100**	**600**	**06**	**24**	**30**

Semester 5 (3rd Year)

Automotive System Design 42 Hours

Unit-I: Design of Clutches & Gearbox: 9 Hrs

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: 8 Hrs

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: 8 Hrs

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: 8 Hrs

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: 9 Hrs

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.

Alternative Fuel and Emission Control 42 Hours

Unit-I: Conventional Fuels and Need for alternative fuels: 9 Hrs

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: 9 Hrs

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): 8 Hrs

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): 8 Hrs

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, chemiluminescence nox analyzer, oxygen analyzer, smoke measurement, constant volume sampling, particulate emission measurement, orsat apparatus.)

Unit-V: Health effects of Emissions from Automobiles: 8 Hrs

Emission effects on health and environment. Emission inventory, ambient air quality monitoring, Emission Norms: As per Bharat Standard up to BS – IV.

Automobile Maintenance Service & Repairs – I 42 hours

Unit 1: Workshop Equipment 9 Hrs

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 8 Hrs

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 8 Hrs

(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 **9 Hrs**

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 **8 Hrs**

(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

Automotive NVH 42 Hours

Unit-I: Introduction to NVH: **9 Hrs**

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,

Unit II Vibrations **8 Hrs**

Basic concepts of vibration, time period, frequency, SHM, types of vibration, Natural frequency, resonance, damping, mathematical models.

Unit-III: Vibration Analysis: **8 Hrs**

Formulating the equations of motion - linear and torsional system. Damped and undamped single degree of freedom system, undamped two degree of freedom systems derivation, coordinate coupling, generalized coordinates.

Unit IV Vibration Control **8 Hrs**

Different types of dampers, vibration absorbers, centrifugal pendulum, dry friction, untuned viscous, vibration isolation

Unit V: Vibration measurement: **9 Hrs**

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.

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

3. Design of automotive gear box along with reverse gear (Two full imperial sheets along with design calculations report) 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

4. Design of suspension spring and its analysis using any analysis software.

Semester 6 (3rd Year)

Automobile Maintenance Service & Repairs – II 42 Hours

Unit 1: Fault Diagnosis 9 **Hrs**

Diagnostic Trouble Codes, ECM Power and Ground Circuit Check, MAP Sensor Circuit, VSS Circuit Check, Fuel Pressure Check, Fuel Injection Circuit Check, Evaporative Emission Control system Check, Inspection of ECM & its Control.

Unit 2: Overhaul and Reconditioning Procedures -1 **8 Hrs**

Overhaul and reconditioning procedures of engine, clutch, gear box

Unit 3: Overhaul and Reconditioning Procedures – 2 **9 Hrs**

Propeller shaft & universal joints, differential, axles, and hubs, Overhaul and reconditioning procedures of steering and suspension system components including McPherson strut. Overhaul and reconditioning procedures of drum and disc brakes

Unit 4: Overhaul and Reconditioning Procedures -3 **8 Hrs**

Service, overhaul and testing of starter motor, alternator, ignition system, wiper motor, electrical fuel pump, horn, flasher unit, wiring harness, condenser, H.T. coil, spark plug.

Unit 5: Reconditioning **8 Hrs**

Overhaul, and testing of diesel fuel injector, single and multi cylinder fuel injection pumps. Calibration, phasing, and spray tests.

Air-conditioning and heating equipment: Faults and their remedies.

Off-Road Vehicles 42 Hours

Unit 1: Classification and Requirements of Off Road Vehicles **8 Hrs**

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 **8 Hrs**

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 **9 Hrs**

Scrappers, elevating graders, motor graders, self powered scrappers 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 9 Hrs

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 8 Hrs

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

Project 8Hours Week

On the basis of learning in the Bachelor of Vocational, a project to be taken up by the student strengthening his/ her vocational skills