STUDY, EVALUATION SCHEME & SYLLABUS

For

B. Voc
Automotive Manufacturing
Technology

Based on

AICTE Model Curriculum

(EFFECTIVE FROM THE SESSION: 2019-20)
### NSFQ Level 5 SEMESTER- I

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GV: General Vocational; VP: Vocational Practical; OJT: On Job Training; SSC: Sector Skill Council.
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UNIT-I:
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.

UNIT-II:
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.

UNIT-III:
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 wheels drive auxiliary gear box. Gear ratio

UNIT-IV:
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

UNIT-V:
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:
(5.GV.02) Automobile Electrical Equipment

UNIT-I:
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 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 in circuits.

UNIT-II:
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-III:
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, interpole, split field and bucking field, Dyna-Starter, Generator drive.

UNIT-IV:
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 V:
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
(5.GV.03) 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, 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 control sin 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:
1. Two and three wheeler technology, dhruv u. Panchal

(5.GV.04) Modern Electric and Hybrid Vehicles

UNIT-I: 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-II: 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-III: Power Flow
Power flow control in electric and hybrid electric drive train topologies.
UNIT-IV: 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-V: 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
3. Electric and Hybrid Vehicles: Design Fundamentals: Iqbal Husain

(5.VP.01) Metrology and Measuring Instruments lab
1. Measurement of angle with the help of sine bar/ Vernier Bevel protractor.
2. Study and sketch of various types of optical projectors.
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 precision balls.
5. To measure external and internal taper with the help of taper gauges, precision rollers.
6. To test the squareness of a component with auto-collimeter.
7. To measure the pitch, angle and form of thread of a screw.
8. To measure the geometry of a gear having involute profile.
9. To measure the straightness of the edge of a component with the help of autocollimeter.
10. To measure the length, breadth, thickness, depth, height with micrometer.
11. To measure the length, breadth, thickness, depth, height, with height gauge and Vernier calipers.
13. Calibration of height gauge/depth gauge.
15. Checking of accuracy of snap gauge with slop gauge.
16. Checking of accuracy of a plug gauge with micrometer.
17. Measurement of areas by polar planimeter.
18. Use of feeler, wire, radius and fillet gauges measurement of standard parameters.
(5.VP.02) 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

Level 5 (Semester II)

(5.GV.06) Total Quality Management

1. Introduction, Basic concepts of total quality management
   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
   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 & Bench marking
   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)
   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)

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:


(5.GV.06) Motor Vehicle Technology - II

UNIT-I 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, gradeability, Idea of Safety features in a modern car.

UNIT-II: 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-III: 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 recalculating 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-IV: 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-V: 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, and Evaporative Emission Control System.

Reference Books:

UNIT-I: 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 intermetallic 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-II: Metals - Ferrous Metals
1. 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-III: NON-METALLIC 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-IV: 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. Materials Science and Engineering, William Callister
(5.GV.08) Rapid Prototyping & Reverse Engineering

UNIT-I: Introduction:
Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

UNIT-II: CAD Modelling and Data Processing for RP:
CAD model preparation, Data Requirements, different types of Data formats, Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

UNIT-III: RP Systems:

UNIT-IV: Rapid Tooling:
Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

UNIT-V: RP Applications:
Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

Reference Books:
1. Reverse Engineering by Kiran J. Fernandes (Editor), Vinesh Raja (Editor)

(5.VP.04) Project

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

(5.VP.05) Engineering Graphics

1. Introduction

Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning line conventions and free hand practicing, AUTO CAD, layout of the software, standard tool bar/menus and description of most commonly used toolbars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP & LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints.
2. Orthographic Projections

Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes.

3. Orthographic Projections of Plane Surfaces (First Angle Projection Only)

Introduction, Definitions – projections of plane surfaces – triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only.

4. Projections of Solids (First Angle Projection Only)

Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions.

5. Sections and Development of Lateral Surfaces of Solids

Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP.

6. Isometric Projection (Using Isometric Scale Only)

Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projection of Tetrahedron, hexahedron (cube), right regular prisms, pyramids, cylinders, cones, spheres, cut Spheres.

Reference Books:

(5.VP.06) Mechanical Workshop Practice

1. SHEET METAL WORKING AND SOLDERING:
   a. (EX-1) Cutting, shearing and bending of sheet.
   b. (EX-2) To prepare a soap case by the metal sheet
   c. (EX-3) To make a funnel with thin sheet and to solder the seam of the same
   d. (EX-4) To make a cylinder and to solder the same
2. FITTING SHOP WORK:
   a. (EX-1) Hack sawing and chipping of M.S. flat
   b. (EX-2) Filing and squaring of chipped M.S. job
   c. (EX-3) Filing on square of rectangular M.S. Plate
   d. (EX-4) Drill a hole in MS Block & tapping the same
   e. (EX-5) Making a Bolt & Nut by Tap & Die set.

3. SMITHY SHOP WORK:
   a. (EX-1) To prepare square angular piece by M.S. rod
   b. (EX-2) To make square or hexagonal head bolt
   c. (EX-3) To make a screw driver with metallic handle
   d. (EX-4) To make ring with hook

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

5. WELDING SHOP WORK:
   a. (EX-1) Welding practice gas & electric arc welding
   b. (EX-2) Welding for lap joint after preparing the edge
   c. (EX-3) Welding Butt joint after preparing the edge
   d. (EX-4) Gas Cutting
   e. (EX-5) `T' joint welding after preparation of edge.

Reference Books:
2. Elements of Workshop Technology Vol. I: BS Raghuwanshi

Level 6 (Semester I)

(6.GV.01) Automobile Electrical System

UNIT-I: 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-II: 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-III: 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-IV: 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 infrared reflective light sources, HID light sources (Xenon and bi-xenon), LED light sources, Blue vision head lamp, Auxiliary lights, Brake light, Fog light, Flasher unit, warning lights and panel lights.

UNIT-V: ACCESSORIES
Fuel and oil pressure gauge, cooling water temperature gauge, electrical speedometer, ampere meter, 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 Engines, A.K. Babu, Khanna Publishing House
2. Automotive Electrical Equipment, Kohli

(6.GV.02) Automobile Drawing & Design

UNIT-I: 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-II: 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-III: Drafting of sectional views of the following assemblies (1) Master cylinder (2) Wheel cylinder (3) Universal joint

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

UNIT-V: Design of the following components of an automobile engine (1) Piston assembly (2) Connecting rod assembly (3) Crank shaft (4) Flywheel
(6.GV.03) Automobile Engines


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

UNIT-II: (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.

UNIT-III: 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).


UNIT-V: 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.
UNIT-I: Tool holders:
Tool holders for turning and milling carbide inserts-types, ISO-designation and applications, Tool holding and tool mounting systems for conventional milling and drilling machine tools.

UNIT-II: Locating and clamping devices:
Concept, meaning and definitions of location and clamping, Use of locating and clamping principles in day-to-day supervision on shop floor, Degree of freedom-concept and importance, 3-2-1 principle of location, Locators-Types, Sketches with nomenclature, Working, Applications, Fool proofing and ejecting.

UNIT-III: Clamping devices:
Types, Sketches with nomenclature, Working, Applications.

UNIT-IV: Jigs and fixtures:
Concept, meaning, differences and benefits of jigs and fixtures, Types, sketches with nomenclature, working and applications of jigs, Types, sketches with nomenclature, working and applications of fixtures.

UNIT-V: Design of Jigs and Fixtures:
Steps in designing jigs and fixture for given simple component.

Reference Books:
1. Mass Production, Products from Phaidon Design Classics


UNIT-II: 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 computerized wheel aligner.

UNIT-III: Measurement of Exhaust Pollution by various analyzers such as Four Gas Analyser, Smoke meter, Noxanalyser.

UNIT-IV: Use of Headlight aligner, Wheel aligner, automotive oscilloscope.
UNIT-V: Servicing: Meaning and scope of servicing, Items attended to in servicing of a vehicle. Servicing a vehicle, Focusing and alignment of head lights

Reference Books:
1. Engine Service: Gary Lewis
2. Various Car’s Manuals

(6.VP.02) Tool & Die Making Lab

1. Manufacture of Box Jig and Angle plate jig
2. Manufacture of “V” Block angle grinding Fixtures and profile milling fixture
3. Manufacture of simple Blanking & piercing Tool
4. Manufacture of Progressive tool for producing a Cycle chain link
5. Manufacture of Press tools like Combination tool & Compound tool
6. Manufacture of Draw tool
7. Trial out On Fly press and power press the Produced components such as V, U, Cycle link, Cup, Washer and Cycle bell cup

Level 6 (Semester II)

(6.GV.05) Automobile Engine Systems


UNIT-II: 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, Antifreeze and anti-corrosive additive, Coolants, Flushing of cooling system.

UNIT-III: 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-IV: 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.


Reference Books:
1. Automotive Engines, A.K. Babu, Khanna Publishing House

(6.GV.06) 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:

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, Psychometric 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:
1. Refrigeration & Air Conditioning, Sadhu Singh, Khanna Publishing House

(6.GV.07) Vehicle Performance & Testing

UNIT-I: Vehicle Performance Parameters:

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:
1. Road Vehicle Performance: Methods of Measurement and Calculation, George Gordon Lucas
2. The Engineering Principles of Vehicle Performance Testing, Fredrick James Furrer

(6.GV.08) 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:

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 accumulator’s hydraulic pumps/motors- pneumatic hybrid engine systems operation modes.

Reference Books:
1. Electric & Hybrid Vehicles, A.K. Babu, Khanna Publishing House
2. Electric and Hybrid Vehicles, Tom Denton

(6.VP.03) 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.
(6.VP.04) 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 I)

(7.GV.01) 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, mutilate 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:
UNIT-I: **Objective of Facility Design:** Types of layout problems, the layout function, organization of layout. Analysis and Design of Material Flow: Systems approach to flow cycle, process charts, flow process charts, Quantitative analysis of material flow; optimal material flow configuration. Space and Area Allocation for Production and Physical Plant Services;

UNIT-II: **Computerized handling of layout algorithms:** Algorithms for computerized Layout Planning, Construction and Development type of computerized Layout Planning Techniques i.e. CRAFT, ALDEP, CORELAP etc.;

UNIT-III: **Product handling:** Design of system configurations conforming to various kinds of product features and layout characteristics; Design concepts of common handling and transfer equipment; Different types of conveyors, elevators, fork lifters;

UNIT-VI: Design concept of warehouse facilities commensurate with adopted kind of handling and transfer devices; Automated Handling of materials, Automated Transfer lines, AGVS, Use of Robots in Product handling, automated packaging devices.

UNIT-V: Application of pneumatic and hydraulic system in transportation and handling of products, Design of integrated plant layout for product handling systems

**Reference Books:**
1. Plant Layout and Materials Handling, R. B. Choudhary, G. R. N. Tagore
2. Plant Layout And Material Handling (Paperback, G.K. Agarwal)

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**(7.GV.03) Industrial Engineering & Safety Engineering**

UNIT-I: **Inspection:** Inspection and its objective, Types of inspection, Inspection standards, Duties of inspection foreman, QUALITY CONTROL: Concept of quality control, elements of quality control, quality control groups, objectives of quality control, Statistical quality control, objectives of S.Q.C. Inspection by variables & attributes, Frequency distribution, mean, median & mode, standard deviation, X-R charts, P-Charts, C-Charts and acceptance sampling. (i) I.S.O. 9000 (ii) KAIZEN (iii) Six Sigma (iv) 5S (v) TQM system, concept & brief idea only

UNIT-II: **Work Study:** Method study-Process chart, Flow process chart, Flow diagram, Man and Machine chart, gang process chart, Work Measurement-Time study, Tools used in time study, Performance rating, Allowance and use of time standard, Time and Motion Study. Principles of human motion economy, Micro-motion study, Memo motion study, Therbligs, left hand and right hand chart.

UNIT-III: **CPM & PERT:** Introduction to CPM, language of CPM net work. Diagram map for CPM chart, arrow diagram method of CPM, Programme Evaluation & Review Technique (PERT) Activity event net work (simple manual cases only), Project scheduling with CPM & PERT.

UNIT-V: MATERIAL HANDLING: Material Handling & material handling equipment, factors in material handling problems, cost reduction through improved material handling, Reduction in time of material handling, Material handling equipment-Idea about lifting lowering devices, Transportation devices, combination devices, Maintenance of material handling equipment.


Reference Books:
1. Industrial Safety, S.C. Sharma, Khanna Publishing House
2. Industrial Engineering Safety and Pollution, Sanjai Kumar Gupta

(7.GV.04) CAD & CAM

UNIT-I: Introduction CIM and CAD & Analysis:

UNIT-II: Computer aided Manufacturing CAM:

UNIT-III: CNC Machine and Components:

UNIT-IV: Part Programming:

UNIT-V: FMS, Integrated Material Handling and Robot:

Reference Books:
1. Engineering AutoCAD, Pradeep Jain & A.P. Gautam, Khanna Publishing House

(7.VP.01) CAD Lab & CAM Lab

1. Introduction and different features of the CAD Software.
2. 2-D Drafting.
3. 3-D Modeling.
4. 3-D Advanced Modeling.
5. Assembly modeling.
6. Feature Modification and Manipulation
7. Detailing.
10. To prepare part programming for plain turning operation.
11. To prepare part programming for turning operation in absolute mode.
12. To prepare part program in inch mode for plain turning operation.
13. To prepare part program for taper turning operation.
14. To prepare part program for turning operations using turning cycle.
15. To prepare part program for threading operation.
16. To prepare part program for slot milling operation.
17. To prepare part program for gear cutting operation.
18. To prepare part program for gear cutting using mill cycle.
19. To prepare part program for drilling operation
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 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

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

Level 7 (Semester II)

(7.GV.05) Vehicle Safety

UNIT-I: Introduction to vehicle safety, Basic concepts of vehicle safety, Risk evaluation and communication Human error control, Universal design, The distracted driver, Crash Testing


UNIT-IV: Antilock braking system, Traction control system, Electronic Stability Program, Low tire pressure warning system, Collision avoidance systems

UNIT-V: Automotive Industry Standards, Transport Engineering Standards, Indian road congress Standards
(7.GV.06) Agile and Lean Manufacturing

UNIT-I: Introduction
Introduction to Just in time production, Toyota production system, Introduction to lean manufacturing (LM), history of LM, advantages of LM over mass production

UNIT-II: Waste Identification
Types of wastes, lean manufacturing principles; Value, value stream, flow, pull and perfection

UNIT-III: Value stream mapping
Introduction to value stream mapping, types of value stream mapping, value added activities, necessary non-value added activities, non-value added activities

UNIT-IV: Lean manufacturing tools
Introduction to 5S, Kanban, kaizen, work standardization, Statistical process control, automation and other lean tools

UNIT-V: Agile manufacturing
Introduction to agile manufacturing, advantages of agile manufacturing, differences with lean manufacturing.

Reference Books:
1. Lean and Agile Manufacturing, Devadasan S.R
2. Agile and Lean Program Management, Johanna Rothman

(7.GV.07) Process Planning and Control

UNIT-I: Introduction, components of forecasting demand, Approaches to forecasting: forecasts based on judgment and opinion, Selection of forecasting technique.

UNIT-II: Capacity Planning-
Defining and measuring capacity, determinants of effective capacity, capacity strategy, steps in capacity planning process, determining capacity requirements, Capacity alternatives, Evaluation of alternatives; Cost-Volume analysis.

UNIT-III: Facility Location-
Need for location decisions, factors affecting location, qualitative and quantitative techniques of location. Facilities layout: Product, Process, Fixed position, combination and cellular layouts; Designing product and process layout, line balancing.

UNIT-IV: Production Control-
Capacity control and priority control, production control functions; Routing, scheduling, dispatching, expediting and follow up, Techniques of production control in job shop production, batch production and mass production systems
UNIT-V: Sequencing-
Priority rules, sequencing methods, sequence jobs through two work centers, scheduling services, application of CPM and PERT techniques.

Reference Books:
1. Process of Planning and Control, Chakrapani Srinivasa

(7.VP.03) Project

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