SHIVAJI UNIVERSITY KOLHAPUR

Syllabus

For

Bachelor of Vocation

in

Automobile

3rd Year Sem – V and VI

Bachelor of Vocation in Automobile

To be implemented from Academic Year 2017-2018 onwards

BACHELOR OF VOCATION (B.Voc.)

Theory Examination Semester V -

Paper Number	Title of Paper (For Semester V)	Total Marks
I	Alternative fuels and emission control techniques	50
II	Industrial Organization and management	50
III	Automotive refrigeration and air conditioning	50
IV	Vehicle hydraulics and Pneumatics	50
	Total	200

Theory Examination Semester VI-

Paper Number	Title of Paper (For Semester VI)	Total Marks
I	Transport management and motor industries	50
II	Automotive Electronics	50
III	Electric and Hybrid vehicles	50
IV	Tractors ,Farm Equipment's and Special Purpose Vehicles	50
	Total	200

Practical Examination semester V and VI-

Semester (V)			Semester (VI)		
Sr. No.	Title of Practical	Marks	Sr. No.	Title of Practical	Marks
P51	Engine testing Lab	50	P61	Automotive Electronics Lab	50
P52	Body repair and Painting Lab	50	P62	Tractor and Farm Equipment Lab	50
P53	Refrigeration and air conditioning Lab	50	P63	Automotive Diagnosis Lab	50
P54	Project-I	100	P64	Project-II	100
	Total	250		Total	250

Structure Of syllabus

Theory Curriculum B. Voc. Part III (Bachelor of Vocation in Automobile)

Semester V				Semester VI			
Sr. No.	**Subjects**	**Credits**	**Evaluation**	**Sr. No.**	**Subjects**	**Credits**	**Evaluation**
1	Alternative fuels and emission control techniques	**3**	**50**	**1**	Transport management and motor industries	**3**	**50**
2	Industrial Organization and management	**3**	**50**	**2**	Automotive Electronics	**3**	**50**
3	Automotive refrigeration and air conditioning	**3**	**50**	**3**	Electric and Hybrid vehicles	**3**	**50**
4	Vehicle hydraulics and Pneumatics	**3**	**50**	**4**	Tractors ,Farm Equipment's and Special Purpose Vehicles	**3**	**50**
Total		**12**	**200**	**Total**		**12**	**200**

Practical Curriculum B. Voc. Part III(Bachelor of Vocation in Automobile)

Semester V				Semester VI			
Sr. No.	**Subjects**	**Credits**	**Evaluation**	**Sr. No.**	**Subjects**	**Credits**	**Evaluation**
	Engine testing Lab	**4**	**50**		Automotive Electronics Lab	**4**	**50**
	Body repair and Painting Lab	**4**	**50**		Tractor and Farm Equipment Lab	**4**	**50**
	Refrigeration and air conditioning Lab	**4**	**50**		Automotive Diagnosis Lab	**4**	**50**
	Project-I	**6**	**100**		Project-II	**6**	**100**
Total		**18**	**250**	**Total**		**18**	**250**

A501- Alternative fuels and emission control techniques

Unit No.	Topics	Hours
1	**Conventional Fuels and Need for alternative fuels** Estimate of petroleum reserve and availability - comparative properties of fuels- diesel and gasoline, quality rating of si and ci engine fuels, fuel additives for si and ci engines. Thermodynamics of fuel combustion - introduction to chemical thermodynamics, chemical reaction - fuels and combustion, enthalpy of formation and enthalpy of combustion, first law analysis of reacting systems, adiabatic flame temperature. need for alternative fuels, applications, types etc.	**10**
2	**Alternative Fuels I – Gaseous Fuels and Biofuel** 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.	**8**
3	**Alternative Fuels II - 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.	**8**
4	**Emission Control (SI Engine)** Emission formation in S.I. engines - Hydrocarbons, carbon monoxide, oxides of nitrogen, polyneculear 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.	**8**
5	**Emission Measurement and Control (CI Engine)** Chemical delay, intermediate compound formation, pollutant formation on incomplete combustion, effect of design and operating variables on pollutant formation, controlling of emissions, emissions and drivability, exhaust gas recirculation, exhaust after treatment – doc, dpf, scr and lnt. measurement and test procedure (ndir analyzers, fid, chemiluminescence nox analyzer, oxygen analyzer, smoke measurement, constant volume sampling, particulate emission measurement, orsat apparatus.)	**8**

6	**Health effects of Emissions from Automobiles** Emission effects on health and environment. Emission inventory, ambient air quality monitoring, Emission Norms: As per Bharat Standard up to BS – IV.	**6**

Reference Books:

1. "Alternative Fuels", Dr. S. S. Thipse, Jaico publications.
2. "Engine Emission", B.P Pundir, Narosa publication.
3. "Internal Combustion Engines", V .Ganesan, Tata McGraw Hill.
4. "Automotive Emission Control", Crouse, W.M. and. Anglin, A.L, McGraw Hill.
5. "IC Engines", Dr. S. S. Thipse, Jaico publications.
6. "Engine Emissions, pollutant formation", G.S .Springer and D.J. Patterson, Plenum Press.
7. ARAI vehicle emission test manual.

A502- Industrial organization & Management

Unit No.	Topics	Hours
1	**Organization** System approach applied to Organization, Necessity of Organization, Principles of Organization, Formal and Informal Organizations **Management** Functions of Management, Levels of Management, Managerial Skills, Importance of Management, Models of Management **Theory of Management** Scientific Management Approach, Administrative Management Approach, Behavioural Management Approach, Modern Management Theories	8
2	**Forms of Ownership** Single Ownership, Advantages and limitations, Partnership, Types of Partners, Advantages and limitations, Joint Stock Company, Formation of Joint Stock Company, Advantages and limitations, Co – operative Societies, Types of Co, operatives, Advantages and limitations, Co – operative Societies, Types of Co – operatives – Advantages and limitations, Public Corporations, Advantages and limitations **Organizational Structure** Line Organization, Advantages and dis–advantages, Functional Organization, Advantages and dis–advantages, Line and Staff Organization , Advantages and dis– advantages, Committee Organization Advantages and dis – advantages	10
3	**Purchasing and Marketing Management** Purchasing – Introduction, Functions of Purchasing Department, Methods of Purchasing, Marketing, Introduction, Functions of Marketing, Advertising	6
4	**Personal Management** Introduction, Functions of Personal Management, Development of Personal Policy, Manpower Planning, Recruitment and Selection of manpower – Scientific selection, Training and Development of manpower, Job Analysis, Job Evaluation and Merit Rating, Wages and Incentives	8
5	**Motivation, Leadership and Entrepreneurship** Motivation, Human needs Maslow's Hierarchy of needs, Motivation – Introduction, Types of Motivation, Attitude Motivation; Group Motivation; Executive Motivation, Techniques of Motivation. **Leadership - introduction** Qualities of a good Leader, Leadership Approach **Entrepreneurship – Introduction** Entrepreneurship Development, Entrepreneurial Characteristics, Need for Promotion of Entrepreneurship, Steps for establishing small scale unit	8
6	**Management Information System** Data and Information, Need, function and Importance of MIS, Evolution of MIS, Organizational Structure and MIS, Computers and MIS, Classification of Information Systems	8

Reference Books:

1. "Industrial Engineering Handbook" , Editor – in – Chief, 4th Edition, McGraw Hill, 19xx E. S. Buffa and R. K. Sarin
2. "Modern Production / Operations Management", 8th Edition, Wiley, 1987 H. J. Arnold and D. C. Feldman
3. "Organizational Behavior" , McGraw – Hill, 1986 J. A. Senn,
4. "Information Systems in Management " , 4th Edition, Wadsworth Inc., 1990 P. Hershey and K. H. Blanchard,
5. "Management of Organizational Behavior – Utilizing Human Resources ", 4th Edition, Prentice – Hall Inc., 1982 M. Mahajan,
6. "Industrial Engineering and production Management" ,Dhanpat Rai and Co. (P) Ltd. , Delhi, 2002 S. Sadagopan,
7. "Management Information System", Prentice Hall of India Pvt Ltd, 1997 C. B. Mamoria
8. "Personnel Management", Himalaya Publishing House – 1989
9. "Industrial Engineering and Management" , O. P. Khanna, Dhanpat Rai Publications (P) Ltd., 2007

A503- Automotive refrigeration and air conditioning

Unit No.	Topics	Hours
1	**Refrigeration Fundamentals** Introduction to refrigeration and vapour compression system, cycle diagram (Carnot cycle, Reverse Carnot cycle, Simple vapor 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	8
2	**Refrigerants and Air conditioning Components** Environmental concerns/Legislation for automotive A/C systems, types and properties of refrigerants, refrigerant oils, refrigerant piping. Future refrigerants, Air conditioning components: Compressors, Condensers, flow control devices, evaporators – Design guidelines, types, sizing and their installation. Accumulators, receiver driers and desiccants. Refrigerant charge capacity determination.	8
3	**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.	8
4	**Psychrometry** Psychometric properties, tables, charts, Psychometric processes, Processes, Combinations and Calculations, ADP, Coil Condition line, Sensible heat factor, Bypass factor.	6
5	**Air Routing & Temperature Control** Objectives, evaporator air flow, through the re-circulating unit, automatic temperature control, duct system, controlling flow, vacuum reserve, testing the air control of air handling systems.	8
6	**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	10

Text Books:

1. Mark Schnubel, “Automotive Heating & Air Conditioning", Thomson Delmar Learning, 3rd edition, NY.

2. William H. Crouse & Donald L. Anglin, "Automotive Air Conditioning. Mc Graw Hill, Inc., 1990.

3. ASHRAE Handbook-1985 Fundamentals

Reference Books:

1. Boyace H. Dwiggins, ”Automotive Air – conditioning”

2. SamSugarman, “HVAC Fundamentals. Fairmont Press, ISBN0-88173-489-6.

3. Paul Weisler, "Automotive Air Conditioning, Reston PublishingCo.Inc.1990.

4. Paul Lung, "Automotive Air Conditioning, C.B, S. Publisher & Distributor, Delhi.

5. MacDonald K. L “ Automotive Air Conditioning “, TheodoreAudel series, 1978

A504- Vehicle hydraulics and Pneumatics

Unit No.	Topics	Hours
1	**Overview of Fluid Mechanics.** Fluid Fundamentals - Classification of Fluid, Properties of fluids like Specific Weight, Specific gravity, Surface tension, Capillarity, Viscosity. Specification of hydraulic oil, Pascal's law,Types of fluid flow- Steady, unsteady, rotational, irrational, laminar, turbulent, one, two and three dimensional flow, Uniform and non-uniform flow. (Definitions and applications only) Pressure Measurement. Concept of atmospheric pressure, gauge pressure, vacuum pressure, Absolute Pressure, Pressure Gauges - Piezometer tube, simple and differential manometer, Manometer, Bourdon tube pressure gauge. Hydrodynamics, Basic principles of fluid flow, Law of continuity and its applications, Energy possessed by the liquid in motion. Bernoulli's theorem and its applications such as Venturimeter, Orifice meter and pilot tube	**10**
2	**Hydraulic Devices** Centrifugal Pumps - Types, Construction and working of centrifugal pump, Types of casing. Need of priming, Heads, Losses and Efficiencies of Centrifugal Pump, Net positive suction head(NPSH), Fault findings and remedies, Pump selection. Reciprocating Pumps - Construction and Working of single and Double Acting Reciprocating pump, Reasons of cavitation and separation. Comparison between Reciprocating and Centrifugal Pump	**8**
3	**Miscellaneous Fluid Machines** Simple Hydraulic Devices - Working principles, construction and applications of Hydraulic jack, Hydraulic ram, Hydraulic lift, Hydraulic press. Other Pumping Devices- Gear pumps used in hydraulic circuits, Vane type, Swash plate type pump. Comparison of above pumps for various characteristics and their applications.	**8**
4	**Basic Components Of Hydraulic and Pneumatic Systems** Hydraulic and Pneumatic actuators. Hydraulic Actuators - Hydraulic cylinders (single, double acting and telescopic) –construction and working, Hydraulic motors(gear and piston type) –construction and working Pneumatic Actuators - Pneumatic cylinders (single and double acting) construction and working, Air motors (gear and piston type) construction and working Valves for Hydraulic and Pneumatic systems Classifications of valves, poppet, ball, needle, throttle, pressure control directional control, sequencing synchronizing ,rotary spool, sliding spool two position, multi position. Non-return valves. Proportionating valve Construction and operation of above valves.	**8**

5	**Accessories of Hydraulic and Pneumatic Systems** Filters - Hydraulic filters and strainers – full flow and proportional types, function and working, difference between filters and strainers. Pneumatic filters –screen type and mechanical type, function and working, FRL unit Hoses and Connectors for hydraulic and pneumatic systems - Types, construction and applications. Seals and Gaskets for hydraulic and pneumatic systems-Types, function,	**6**
6	**Hydraulic and Pneumatic Circuits** Hydraulic Circuits, Hydraulic symbols**,** Meter in, Meter out. Bleed off, Sequencing, Introduction to electro-hydraulics – concept, principles and applications**,** Applications of hydraulic circuits – Hydraulic power steering, Hydraulic brakes, milling machine, hydraulic press, Simple Pneumatic Circuits Pneumatic symbols, Speed control circuit (Meter in, Meter out), Sequencing, Applications of pneumatic circuits – Air brake, Low cost Automation in industries, Pneumatic power tools (drill, hammer, and grinder), Comparison of Hydraulic and pneumatic circuits.	**8**

Reference Books:

Dr. P. N. Modi, Dr. S.M. Seth - Hydraulic and Fluid Mechanics Standard Book House,Delhi

Pippengen and Hicks Industrial Hydraulics Tata McGraw Hill Int.

S. Ilango and V. Soundararajan - Introduction to Hydraulics And Pneumatics, PHI Learning PrivateLimited, New Delhi.

Anthony Esposito Fluid Power PEARSON Education, Noida

R.J. Garde and A.G. Mirajgaoker Engineering Fluid Mechanics SITECH Publications (India) PVT. LTD.

K. Shanmuga Sundaram - Hydraulic and Pneumatic, Controls S. Chand

P51 Engine Testing Lab

1. Study of Pressure pickups, charge amplifier, storage oscilloscope and signal analysers used for IC engine testing.
2. Performance study of petrol and diesel engines both at full load and part load conditions.
3. Morse test on petrol and diesel engines.
4. Determination of compression ratio, volumetric efficiency and optimum cooling water flow rate in engines.
5. Heat balance test on an automotive engine. Testing of 2 and 4 wheelers using chassis dynamometers.
6. Measurement of HC, CO, CO2, O2 using exhaust gas analyser
7. Diesel smoke measurement.
8. Sectional working model for four stroke cycle diesel engine.
9. Sectional light weight models of IC Engine, injection system and carburetor, sectional working model for 2 stroke petrol engine.

P52 Body repair and painting Lab

1. Remove and refit body panels, doors, floors, wheel boxes and fenders, wind shield glasses
2. To carryout body repair by different welding processes on a vehicle
3. To carryout polishing /refinishing operation on vehicle
4. Identification of various metals.
5. Metal surface cleaning (manually) & Surface cleaning (chemical) 1) Pickling
   2) Deareasing 3) Degusting 4) Phosphate 5) Passivation 6) Activation
   7) Electroplating 8) Viscosity measurement by ford cup.
6. Buffing on metals.
7. Stepwise painting process
8. Dent removing process/ denting painting
9. Anticorrosion treatment to the vehicle
10. Adhesion testing
11. Colour gloss test by gloss meter
12. P.H. value testing

P53 Refrigeration and air conditioning Lab

List of Experiments:-

1. Test on vapour 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.

P54 Project-I

1. To provide an opportunity to students do work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the teachers.

2. To encourage creative thinking process to help them to get confidence by planning and carrying out the work plan of the project and to successfully complete the same, through observations, discussions and decision making process. Project Load: Maximum 9-10 students in one batch, involving 03 groups Maximum 9-10 students shall work under one Faculty Member Group of one student is not allowed under any circumstances.

Project Definition: Project work shall be based on any of the following:

1. Fabrication of product/ testing setup of an experimentation unit/ apparatus/ small equipment, in a group.

2. Experimental verification of principles used in Mechanical Engineering Applications.

3. Projects having valid database, data flow, algorithm, and output reports, preferably software based.

Project Term Work: 100 Marks

The term work under project submitted by students shall include and assessment of Term work should be as below

Marks : 1 Work Diary: 20 Marks for Semester V Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for

1. Searching suitable project work

2. Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring out the project.

3. Brief report of feasibility studies carried to implement the conclusion.

4. Rough Sketches/ Design Calculations, etc. 2

Synopsis: The group should submit the synopsis in following form.

1. Title of Project

2. Names of Students

3. Name of Guide

4. Relevance

5. Present Theory and Practices

6. Proposed work

7. Expenditure

8. References The synopsis shall be signed by the each student in the group, approved by the guide and endorsed by the Head of the Department

A601- Transport management and motor industries

Unit No.	Topics	Hours
1	**Motor Vehicle Act** Short titles and definitions, laws governing to use of motor vehicle and vehicle transport, licensing of drivers and conductors, registration of vehicle, state and interstate permits, traffic rules, signals and controls, accidents, causes and analysis, liabilities and preventive measures, rules and regulations, responsibility of driver, public and public authorities, offences, penalties and procedures, different types of forms, government administration structure, personnel, authorities and duties, rules regarding construction of motor vehicles. new motor vehicle act.	**10**
2	**Taxation** Objectives, structure and methods of laving taxation, onetime tax, tax exemption and tax renewal.	**6**
3	**Insurance** Insurance types and significance, comprehensive, third party insurance, zero depth insurance, furnishing of particulars of vehicles involved in accident, mact (motor accident claims tribunal), solatium fund, hit and run case, duty of driver in case of accident, surveyor and loss assessor, surveyor's report estimation and valuation of vehicle: role of surveyor procedure of survey and valuation of vehicle. Accident survey report. importance of warranty system and protection of law: how to deal with defects, benefits of warranty system.	**10**
4	**Passenger Transport Operation** Structure of passenger transport organizations, typical depot layouts, requirements and problems on fleet management, fleet maintenance, planning - scheduling operation and control, personal and training- for drivers and conductors, public relations, propaganda, publicity and passenger amenities, parcel traffic., theory of fares-basic principles of fare charging, differential rates for different types of services, depreciation and debt charges, operation cost and revenues, economics and records working of various state transport organizations.(MSRTC, BEST)	**8**
5	**Goods Transport** Structure of goods transport organizations, scheduling of goods transport, management information system (mis) in passenger / goods transport operation, storage and transportation of petroleum products.	**6**
6	**Advance Techniques in Traffic Management and Motor Industry** Traffic navigation, global positioning system functions and role of automobile industry: the automobile industry in india (collection of data of various companies) various research organizations like-central institute of road transport, automotive research association of india, vehicle research, development and establishment, central road research institute and petroleum conservation and research association	**8**

Reference Books:

1. P. Sudarsanam. Passenger Amenities in STU CIRT, Pune
2. P. Sudarsanam. Fare structure in STU CIRT, Pune
3. P. Sudarsanam. Bus station Management CIRT, Pune.
4. P. Sudarsanam Bus and Crew scheduling CIRT, Pune.
5. O.P. KhannaIndustrial Organization and Management , Dhanpat Rai and sons
6. P.G. Patankar.Director.Compedium of Transport Terms, CIRT, Pune
7. Bharat Kalaskar Vahan Mitra Sanjivini Prakashan, Pune
8. Book Of The Car -Drive Publications Limited Automobile Association

Motor Vehicle Acts

1. Motor Vehicle Act, 1988 Home Department (M .S.)
2. Central M. V. Rules 1989 Home Department (M .S

A602- Automotive electronics

Unit No.	Topics	Hours
1	**Automotive Electronics** Current trends in modern automobiles Open and close loop systems-Components for electronic engine management. Electronic management of chassis system. Vehicle motion control.	6
2	**Charging System** Generation of direct current. Shunt generator characteristics. Armature reaction. Third brush regulation. Cut-out. Voltage & current regulators. Compensated voltage regulator alternators principle & constructional aspects and bridge benefits.	8
3	**Ignition Systems** Types, Construction & working of battery coil and magneto ignition systems. Relative merits, Centrifugal and vacuum advance mechanisms, types and construction of spark plugs, electronic ignition systems.	7
4	**Electronic Fuel Injection and Ignition Systems** Introduction, feedback carburettor systems. Throttle body injection and multi-port or point fuel injection. Fuel injection systems, Injection system controls. Advantages of electronic ignition systems: Types of solid-state ignition systems and their principle of operation, Contact less electronic ignition system, and electronic spark timing control	10
5	**Sensors and Actuators** Basic sensor arrangement, Types of sensors such as-Oxygen sensors, Crank angle position sensors-Fuel metering/vehicle speed sensor and detonation sensor-Altitude sensor, flow sensor. Throttle position sensors. Solenoids, stepper motors, and relays.	9
6	**Digital Engine Control System** Open loop and closed loop control systems-Engine cranking and warm up control-Acceleration enrichment-Deceleration leaning and idle speed control. Distributor less ignition-Integrated engine control systems, Exhaust emission control engineering.	8

Reference Books:

1. Kholi. P.L., Automotive Electrical Equipment, Tata McGraw-Hill Co. Ltd. New Delhi, 19752. Young. 2. A.P., & Griffiths. L., Automobile Electrical Equipment, English Language Book Society & New Press, 1990.

3. Vinal. G.W. ,Storage Batteries, John Wiley & Sons Inc., New York, 1985.

4. Crouse. W.H. ,Automobile Electrical Equipment, McGraw Hill Book Co Inc., New York, 1980 5. Spreadbury. F.G. Electrical ignition Equipment, Constable & Co. Ltd., London 1962.

A603- Electric and hybrid vehicles

Unit No.	Topics	Hours
1	**Electric Vehicles and Motors** Electric vehicle, introduction, components, advantages, disadvantages, applications, vehicles. DC motors series wound- shunt wound- compound wound and separately excited motors AC motors Induction- synchronous- brushless DC motor- switched reluctance motors.	8
2	**Hybrid Vehicles and Propulsion Methods Introduction** Introduction to hybrid vehicles performance characteristics of road vehicles; calculation of road load- predicting fuel economy- grid connected hybrids.	6
3	**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.	10
4	**Fuel Cells** Fuel cell characteristics- fuel cell types – alkaline fuel cell- proton exchange Membrane; direct methanol fuel cell- phosphoric acid fuel cell- molten carbonate fuel cell- solid oxide fuel cell- hydrogen storage systems- reformers- fuel cell EV- super and ultra-capacitors- PEM fuel cell vehicles..	10
5	**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.	8
6	**Nonelectric Hybrid Systems** Short term storage systems flywheel accumulators. Continuously variable transmissions hydraulic accumulator’s hydraulic pumps/motors- pneumatic hybrid engine systems operation modes.	6

Text Books:

1. ''The Electric Car: Development and Future of Battery- Hybrid and Fuel Cell Cars", Mike Westbrook- M H Westbrook- British library Cataloguing in Publication Data.

2. ''Electric and Hybrid Vehicles",Robin Hardy- Iqbal Husain- CRC Press.

3. "Propulsion Systems for Hybrid Vehicles", John M. Miller Institute of Electrical Engineers- London. 4."Alternative Fuels", S.S.Thipse, Jaico publications

Reference Books:

1. Energy Technology Analysis Prospects for Hydrogen and Fuel Cells- International Energy Agency- France.

2. Handbook of Electric Motors- Hamid A Toliyat- Gerald B Kliman- Marcel Decker Inc.

A604- Tractors, Farm equipments and Special Purpose equipments

Unit No.	Topics	Hours
1	**EQUIPMENTS AND OPERATION**: Different types of earth moving equipment's and their applications. Dozers, Loaders, Shovels, Excavators, Scrapers, Motor graders, Rollers, Compactors, Tractors and Attachments.	6
2	**ENGINE** All systems of engine and special features like Automatic injection timer, turbochargers, after coolers etc **TRANSMISSIONS AND FINAL DRIVES** Basic types of transmissions, auxiliary transmission ,compound transmission, twin triple countershaft transmissions and planetary transmission, constructional and working principles, hydro shift automatic Transmission and retarders. FINAL DRIVES: types of reductions like, single reduction, double reduction final drives and planetary final drives, PTO shaft	10
3	**UNDER CARRIAGE AND SUSPENSION** Tyre and tracked vehicles , advantages and disadvantages, under carriage components like , tracks, roller frames, drive sprockets, track rollers, track chains and track shoes. SUSPENSION: rubber spring suspension and air spring suspension.	8
4	**STEERING AND BRAKES** Power steering types like, linkage type power steering, semi integral power steering & integral power steering. STEERING OF TRACKED VEHICLES Skid steering, articulated steering, clutch /brake steering system, controlled differential steering system and planetary steering system. BRAKES: Types of brakes like, disc brake, engine brakes etc.	8
5	**EARTH MOVING EQUIPMENTS MAINTENANCE & SAFETY:** Types of maintenance schedules purpose and advantages, organization set ups, documentation. Safety methods for earth moving equipment's.	6
6	**METHODS OF SELECTION OF EQUIPMENTS** 1) Selection of machines 2) Basic rules of equipment's including the nature of operation 3) Selection based on type of soil 4) Selection based on haul distance 5) Selection based on weather condition	10

Reference Books:

TEXT BOOKS:

1. Diesel equipment- volume I and II by Erich J.schulz

2. Construction equipment and its management By S.C. Sharma

REFERENCE BOOKS:

1.Farm machinery and mechanism by Donald R. hunt and L. W.garner

2.Theory of ground vehicles by J.Y.Wong john wiley and sons

3.Moving the earth by Herbert Nicholas

4.On and with the earth by Jagman Singh, W.Newman and Co. culkatta

P61 Automotive Electronics Lab

1. Study of rectifier and filters, Characteristics of amplifiers,
2. Study of Logic Gates, Adder and Flip-Flops,
3. Study of SCR and IC timer, D/A and A/D converter,
4. Study of Assembly language programming exercise,
5. Study of Interfacing A/D converter and simple data acquisition,
6. Study of Interfacing Stepper motor control and CRT terminal,
7. Study of Micro controller programming and interfacing,
8. Study of battery charging system and setting of regulators and out.
9. Study of battery ignition system

P62 Tractor and Farm Equipment Lab

1. Introduction to transmission systems and components.
2. Study of different types of gear box and calculation of speed ratios.
3. Study on differential and final drive of a tractor.
4. Study of brake system of a tractor.
5. Study of advances in tractor systems and controls.
6. Introduction to various farm machines and visit to implement's shed.
7. Study of rotary duster.
8. Construction and working of rotavator.
9. Field capacity and field efficiency measurement of tillage and planting equipment.
10. Draft & fuel consumption measurement of different implements.
11. Working of seed-cum-fertilizer drill and its calibration.
12. Working of planters.
13. Weeding equipment's and their use.
14. Study of knapsack and foot sprayers.

P63 Automotive Diagnosis Lab

1. Study and layout of an automobile repair, service and maintenance shop.
2. Study and preparation of the list of different types of tools and instruments required Minor and major tune up of gasoline and diesel engines
3. Study and fault diagnosis in electrical ignition system of gasoline fuel system, diesel fuel system and rectification
4. Study and fault diagnosis of faults in the electrical systems such as Head lights, Side of Parking lights, Traffic indicator lights.
5. Study and fault diagnosis of Electric horn system, Windscreen wiper system.
6. Study and fault diagnosis of starter system and charging system
7. Study and fault diagnosis of fuel filters (both gasoline and diesel engines) and air cleaners (dry and wet)
8. Study and fault diagnosis of door lock and window glass rising mechanisms

P64 Project II

1. To provide an opportunity to students do work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the teachers.
2. To encourage creative thinking process to help them to get confidence by planning and carrying out the work plan of the project and to successfully complete the same, through observations, discussions and decision making process.
3. Project Load: Maximum 9-10 students in one batch, involving 03 groups Maximum 9-10 students shall work under one Faculty Member Group of one student is not allowed under any circumstances.
4. Project Definition: Project work shall be based on any of the following:

   1. Fabrication of product/ testing setup of an experimentation unit/ apparatus/ small equipment, in a group.

   2. Experimental verification of principles used in Mechanical Engineering Applications.

   3. Projects having valid database, data flow, algorithm, and output reports, preferably software based.

   Project Term Work: The term work under project submitted by students shall include and assessment of Term work should be as below

   1 Work Diary: 25 Marks Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for

   1. Searching suitable project work

   2. Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring out the project.

   3. Brief report of feasibility studies carried to implement the conclusion.

   4. Rough Sketches/ Design Calculations, etc.

   PROJECT REPORT FORMAT

   Project Report:

   Project report should be of 60 to 70 pages. For standardization of the project reports the following format should be strictly followed.

   1 Page size: Trimmed A4

   2. Top Margin: 1.00 Inches

   3. Bottom Margin: 1.32 Inches

   4. Left Margin: 1.5 Inches

   5. Right Margin: 1.0 Inches

   6. Para Text: Times New Roman 12 point font

   7. Line Spacing: 1.5 Lines

   8. Page Numbers: Right aligned at footer.

   Font 12 point Times New Roman Headings: New Times Roman, 14 point, Boldface 10. Certificate: All students should attach standard format of Certificate as described by the Department. Certificate should be awarded to batch and not individual student Certificate should have signatures of Guide, Principal, and External Examiner.

   Entire Report has to be documented as one chapter.

11 Index of Report: i) Title Sheet ii) Certificate iii) Acknowledgement iv) Table of Contents v)Synopsis vi) List of Figures vii) List of Photographs/ Plates viii)List of Tables

1. Introduction
2. Literature Survey/ Theory
3. Design/ Experimentation/ Fabrication/ Production/ Actual work carried out for the same. 4. Observation Results
5. Discussion on Results and Conclusion

12 **References**: References should have the following format For Books:

"Title of Book"; Authors; Publisher; Edition; For Papers: "Title of Paper"; Authors; Conference Details; Year.

Presentation: On the Basis of Continuous assessment

A) The group has to make a presentation before the faculties of department