

**Scheme of Teaching and Examination for
6 th Semester of 3 Years Diploma in Automobile Engineering**

Duration of Semester : **14 Weeks**
 Student Contact Hours : **36 Hrs (Max.)**
 Total Marks : **800**
 Effective from : 2017 -18 Session

Sl. No.	Name of Subject	Subject Code	Subject	Teaching Scheme			Examination Scheme					
				L	T	P	Hours of Exam	Full Marks of Subject	Final Exam / committee marks	Internal Assessment	Pass Marks Final / Ext. Exam	Pass Marks in Subjects
1.	Industrial Engineering & Management	601	Theory	3		-	3	100	80	20	26	40
2.	Heavy Automotive Machineries	AUT 604	Theory	3		-	3	100	80	20	26	40
3.	Automotive Elect. & Electronics	AUT 605	Theory	3	-	-	3	100	80	20	26	40
4.	Aerodynamics & Design	AUT 606	Theory	3	-	-	3	100	80	20	26	40
5.	Elective II	MEC607/AUT607/ AUT608/MEC610	Theory	3	-	-	3	100	80	20	26	40
6.	Automotive Electrical & Electronics Lab	AUT 609	Practical	-	-	2	4	50	40	10	-	20
7.	Aerodynamics & Design Lab	AUT 610	Sessional	-	-	2	-	50	30	20	-	25
8.	Heavy Automotive Machineries Lab	AUT 611	Sessional	-	-	2	-	50	30	20	-	25
9.	Elective II Lab	MEC614/AUT612/ AUT613/MEC617	Sessional	-		2	-	50	30	20		25
10.	Project Work	603	Sessional	-	-	4	-	50	30	20	-	25
11.	Professional Practices	602	Sessional	-	-	4	-	50	30	20	-	25
Total Hours of Teaching per week :				15		16						

Elective (Mechatronics – MEC 607/ Automobile Air Conditioning –AUT 607/ Vehicle Maintenance.- AUT 608/ Alt. Source of Energy- MEC 610)

Total Marks: Theory : Practical : Sessional :
 L : Lecture, T : Tutorial P : Practical

- Note:
1. Period of Class hours should be of 1 hrs duration as per AICTE norms.
 2. Remaining Hrs every week has been marked for students for Library and Student Centered Activities.
 3. Drawing / Graphics / Practical / Sessional examinations will be held at parent institution.
 4. Board will depute examiner for Practical examination.
 5. Regarding sessional examination the parent institution will form a three member committee and this committee will examine the sessional records and hold viva of the examinee for 60 % marks allotted to the subject. Marks for remaining 40 % will be provided by the Faculty concerned on the basis of evaluation of each job / work throughout the semester.

Subject Name : Industrial Engineering & Management (Common paper)
Subject Code : 601
Full Marks : 80+20= 100

L	T	P
3	0	0

Rationale:

After completion of three years of technical training, Polytechnic students are expected to enter in to the World of Work. The business environment is altogether different and new to the students. A proper introduction and understanding of Business Processes is therefore essential for all Polytechnic students. Management is a subject which deals with basics of Management science required to understand the processes the in Industrial & Commercial environment. This will enable the students of Polytechnic to become familiar and to understand various Business Organizational structures, their functioning and the Role these technicians will have to play in these setups with responsibilities.

Industrial Engineering is concerned with the design, improvement and installation of integrated systems of people, materials, equipment and energy. Polytechnic students must be able to analyze the use and cost of the resources of the organization in order to achieve the objective, i.e. to increase productivity, profits etc. and carryout the policies efficiently and effectively.

Objective :

The students will able to:

1. Familiarize environment in the world of work.
2. Explain the importance of management process in Business.
3. Identify various components of management.
4. Describe Role & Responsibilities of a Technician in an Organizational Structure.
5. Apply various rules and regulations concerned with Business & Social responsibilities of the technician.

Detailed Syllabus

1. Productivity :

02 Hrs

Production and productivity, importance of productivity, factors affecting productivity, means of increasing productivity.

2. **Plant Layout and Material Handling :** **02 Hrs**
Definition of plant layout, objectives of good plant layout, principles of plant layout, types of plant layout, flow pattern, steps in planning the layout for a new enterprise, definition of material handling, functions and principles of material handling, material handling devices.
3. **Work Study :** **04 Hrs**
Definition, concept and need for work study, objectives of method study and work measurement, basic procedure/steps in method study, recording technique, critical examination, principles of motion economy, stop watch procedure for collecting time study data, including performance rating and allowances, work sampling.
4. **Production Planning and Control (PPC) :** **04 Hrs**
Definition and objectives of PPC, functions of PPC, routing, scheduling, loading, dispatching, production control definition and objectives, principle of sound production control system.
5. **Material, Purchase and Stores Management :** **04 Hrs**
Definition, functions& objectives of materials management, inventory control, economic order quantity (EOQ), ABC analysis. Objectives of purchasing department, buying techniques, purchasing procedure (steps involved in one complete purchasing cycle); functions of stores department, location and layout of stores, receipt and issue of materials.
6. **Quality Control and TQM :** **04 Hrs**
Meaning of quality and quality control, dimensions of quality, quality circle, concept and definition of TQM, elements of TQM, Kaizen, 5 'S' and six sigma.
7. **Management :** **04 Hrs**
Various definition, concept of management, levels of management, administration and management, scientific management by F. W. Taylor. Principles of management (14 principles of Henry Fayol). Functions of management - planning, organizing, coordinating, directing, controlling, decision making.
8. **Organizational Management :** **04 Hrs**
Organization - definition, steps in forming organization. Types of organization. Types of organization - line, line and staff, functions, project type. Departmentation- Organized and decentralized, authority and responsibility, span of control (management). Forms of ownership - proprietorship, partnership, joint stock company, co-operative society, govt. sector.

9. **Human Resource Management :**

06 Hrs

Personnel Management – Introduction, definition, function. Staffing – Introduction to HR, Introduction to HR Planning, Recruitment procedure. Personnel- Training & Development – Types of training, Induction, Skill enhancement. Leadership & Motivation – Leadership- Styles & types, Motivation- Definition, Intrinsic, &Extrinsic, Maslow's theory of Motivation and its significance. Safety Management – Causes of accident, Safety Procedures. Introduction, Objectives & feature of Industrial Legislation such as – Factory act, ESI act, Workman compensation act, Industrial dispute act and salary & wages.

10. **Financial Management :**

04 Hrs

Financial Management- Objectives & Functions. Capital Generation & Management- Types of capitals, Sources of finance. Budgets and accounts- Types of budgets, Production budget (including variance report), Labour budget, Introduction to Profit & Loss Accounts (Only concept), Balance sheet etc.

11. **Entrepreneurship :**

04 Hrs

Concept and definition of entrepreneur and entrepreneurship, factors influencing entrepreneurship, entrepreneurial characteristics, need for promotion of entrepreneurship and small scale industries, steps in setting up a small scale industrial enterprise.

References Books :

1. Industrial Engineering and Management by O. P. Khanna
2. Industrial Engineering and Production Management by M. Mahajan.
Publisher : Dhanpat Rai Publication (P) Ltd. New Delhi
3. Business Administration and Management by Dr. S. C. Saxena
Publisher : Sahitya Bhawan, Agra.

Subject : Heavy Automotive Machineries
Subject Code : AUT604
Full Marks : 80+20=100
Hours : 42

1. **Introduction to Automotive Heavy Equipment** - 02 Hrs
 - 1.1 - Introduction, Classification, Uses, Specifications, Shape and size, Operations, Maintenance, Spares, Training, Comparison between common automobile and Automotive Heavy Equipment.
2. **Cooling, Lubrication and Fuel Supply System** - 04 Hrs
 - 2.1 - Introduction, Cooling system - Function, Block diagram, Main components, working.
 - 2.2 - Lubricating system - Function, Block diagram, Components- Oil pump, Pressure Regulator, Oil Filter, Oil cooler, Piston cooling, working.
 - 2.3 - Fuel supply system - Function, PTG and PTR Fuel system- , Block diagram, Components - Fuel tank, primary filter, gear pump, pulsation damper, Magnetic screen, Aneroid valve, Governor, Weight assist plunger, Speed control mechanism, Throttle shaft, Shut down valve, Injector, Special type governors.
3. **Dozer** - 04 Hrs
 - 3.1 - Introduction, Construction, Classification, Components- Blade, Arms, Push arms, Pitch arms, Under carriage units.
 - 3.2 - Transmission- Block diagram and operation, Blade Operations.
 - 3.3 - Hydraulic system- Block diagram and operation, Comparison of cable control and hydraulic control blade operation, Operation of dozer.
4. **Shovel** - 06 Hrs
 - 4.1- Introduction, Construction, Classification.
 - 4.2 - Transmission system - Block diagram and operation, Crowd and bucket hoist shaft, Boom hoist shaft, Swing and propel shaft.
 - 4.3 - Undercarriage unit - Block diagram and operation, Superstructure and its attachment.
 - 4.4 - Hydraulic shovel - Construction, Bottom discharge bucket, Two section bottom dump bucket, Side discharge bucket, Cyclic operation of shovel, Shovel installation.
5. **Front End Loader** - 06 Hrs
 - 5.1 - Introduction, Classification, Construction of wheeled loader and crawler loader, Components- Bucket, Arms.
 - 5.2 - Transmission system - Conventional type, hydrostatic type, Block diagram and working.
 - 5.3 - Hydraulic system -Block diagram and working, Hold position, Raising or lowering bucket, Float position, Tilting position.
 - 5.4 - Steering system - Block diagram and working of wheel mounted, Right turn, Left turn, Neutral, Crawler mounted steering, Operation of loader, Comparison of crawler mounted unit and wheel mounted unit.

6. **Dragline** - 04 Hrs
- 6.1 - Introduction, Classification, Construction, Components- Bucket construction, Boom, Power transmission system.
 - 6.2 - Walking mechanism - Eccentric type (Mechanical type), Hydraulic Ram type.
 - 6.3 - Installation of dragline, Working cycle of dragline, Starting and stopping procedure, Maintenance, Comparison of dragline and shovel.
7. **Clamshell** - 02 Hrs
- 7.1 - Introduction, Classification, Construction, Components - Buckets, Grapples, Reeving, Tagline.
 - 7.2 - Operation - Digging, Dumping, Chopping, Signals, Deep digging, Application.
8. **Scraper** - 04 Hrs
- 8.1 - Introduction, Classification, Construction, Components - Bowl, Apron, Cutting edge.
 - 8.2 - Transmission system - Block diagram and working.
 - 8.3 - Hydraulic system - Block diagram and working, Activities of scraper, Cyclic operation.
9. **Motor Grader** - 06 Hrs
- 9.1 - Introduction, Classification, Construction, Components - Blade and Circle.
 - 9.2 - Transmission system - Block diagram and working.
 - 9.3 - Steering system - Block diagram and working.
 - 9.4 - Hydraulic system - Block diagram and working, Comparison of mechanical controlled grader and hydraulic controlled grader, Functions of grader, Cyclic operation.
10. **Road Roller** - 02 Hrs
- 10.1 - Introduction, Classification, Construction.
 - 10.2 - Smooth steel Rollers, Sheep's foot roller, Pneumatic roller, Pad roller, Roller with falling weight, Pendant Tamper, Vibrating compactor, Three axle tandem rollers.
11. **Crane** - 02 Hrs
- 11.1 - Introduction, Classification, Construction, Application, Stability, High Boom Hazards, Overhead Obstructions, Avoiding other accidents, Breaker Balls.

Subject- Heavy Automotive Machineries Lab

Subject Code- AUT611

List of Practical:-

1. Visit to a mine to observe various operations of Automotive Heavy Equipments. Write a report on the visit.

Book:

- | | |
|-----------------|--------------------------------|
| 1. Jagman Singh | Art of Earth Moving |
| 2. Radichev | Tractors and Automobile |
| 3. Burge | Tractors and their power units |
| 4. Trucker | Earth Moving Plant |

Subject : Automotive Electrical & Electronics
 Subject Code : AUT605
 Full Marks : 80+20=100
 Hours : 42

Content -

1	Electrical & Electronic Components <ol style="list-style-type: none"> 1. Purpose and operation of electrical components like switches, relays, solenoids, buzzers, and resistors. 2. Purpose of circuit protection devices like fuses, maxi fuses, circuit breakers and fusible links 3. Testing of circuit defects like open circuit, shorts, shorts to grounds, voltage drop. Working of Electromagnetic gauges like temp Gauges, fuel gauge, engine oil pressure gauge, Speedo- meter gauge. 4. Working of electrical accessories like wind shield wiper, washer pumps, blower motor, electro chromic mirror, power window, power seat, power door lock. 	6
2	Battery <ol style="list-style-type: none"> 1. Lead acid battery and lithium ion battery—components & operation. 2. Maintenance free battery—construction. 3. Concept of Low maintenance battery. 4. Battery ratings and specifications. 5. Battery maintenance and safety precautions. 6. Capacitor, super capacitor & ultra capacitor- component & operation. 7. Capacitor rating and specification 8. Fuel- cell technology. 	06
3	Starting And Charging System Part A Starting system: Condition at starting. Behaviour of starter during starting. Series motor and its characteristics. Principle & construction of starter motor. Working of different starter drive units, care and maintenance of starter motor. Starter switch. Charging system: generation of direct current. Shunt generator characteristics. Armature reaction. Third brush regulation. Cut-out. Voltage and current regulator. Compensated voltage regulator alternators principle and construction aspects and their benefits. Working principle of hybrid and electric vehicle- parallel, series, combined series-parallel, complex hybrid.	06
4	Ignition Systems: types, construction and working of battery coil and magneto ignition system. Types and construction of spark plugs, electronics system. TCI and CDI ignition system. Advantage of electronics ignition system: Types of solid – state ignition system and their principle of operation, contactless electronics ignition system and electronics spark timing control.	06

05	<p>Electronics Fuel system</p> <p>Introduction throttle body injection and multiport or point fuel injection, fuel injection system, injection system control, sensor and actuators of CRDI system.</p> <p>Sensor and actuator: Basic sensor arrangement, types of sensors such as – oxygen sensor, crank angle position sensor, fuel metering/vehicle speed sensor and detonation sensor- altitude sensor, flow sensor. Throttle position sensor. Solenoids, stepper motor and relays.</p>	06
06	<p>Advanced accessories-fundamentals</p> <ol style="list-style-type: none"> 1. Operation of automatic headlight. 2. Operation of automatic rain sensing wiper. 3. Operation of parking sensor and adaptive cruise control. 4. Operation of common anti-theft system 5. purpose and operation of automatic door lock system. 6. Actuator and sensor of ABS,TCS,EBD,ESP 	06
07	<p>Diagnosis of electronic components & Systems</p> <ol style="list-style-type: none"> 1. Sensor testing:- Oxygen sensor, Engine coolant sensor, Intake air temp. sensor, Throttle position sensor, Manifold absolute pressure sensor. 2. Electronic fuel Injector testing:-only sound test, Ohmmeter test. 3. On board diagnosis (OBD):- 4. Purpose of (on board diagnostic second generation) OBDII, flash codes of Malfunction indicator light. 5. OBDII terminology:- Drive cycle, Trip, Warm up cycle (Definitions only) 6.3.3 SAEJ2012 standards Diagnostic Trouble Code (DTC):- 5digitonly 6. Troubles of electronic gauges like. 	06
Total		42

Subject : Automotive Electrical & Electronics Lab
Subject Code : AUT609

1. Measure the specific gravity of electrolyte of a battery. Also perform high rate discharge test and load test of battery.
2. In a given alternator identify all its components and perform the following test-
 - a. Output test
 - b. Regulated Voltage output test
 - c. Charging circuit resistance test
 - d. Electrical testing of stator and rotor
3. In a starter motor, identify all its components and perform the following test-
 - a. Current Draw test.
 - b. Voltage Drop test
4. In a multi cylinder engine adjust the ignition timing with strobe (neon light)
5. In an engine inspect spark plug cords. Measure and set the spark plug gap and also measure the voltage at spark plug.
6. In an engine locate and identify all the sensors.
7. In a vehicle locate and identify different switches, relays gauges, solenoids, buzzers and fuses.
8. Assignments On Board Diagnosis.
9. Study of accessories like- windshield wiper, washer pump, blower motor, power window.
10. Study of operation of keyless entry, Anti theft system, Automatic Door lock system.

Books:

- | | | | |
|----|---------------------------------|---|----------------------|
| 1. | Barry Hollenbeck | Automotive Electricity, Electronics
& Computer Control | Delmar Publisher |
| 2. | Jack Erjavec, Robert
Scharff | Automotive Technology:
A System Approach | Delmar Publisher Inc |
| 3. | P.L. Kohili | Automotive Electrical Equipment | Tata McGraw-Hill |
| 4. | Trevor Mellard | Automotive Electronic System | ELBS |

Subject : Aerodynamics and Design
Subject Code : AUT606
Full Marks : 80+20=100
Hours : 42

Content:

1. Introduction to Aerodynamics -

1.1 - Scope, historical developments, Resistance to vehicle motion, Performance, Fuel consumption, Performance potential of vehicle aerodynamics.

1.2 - Engine cooling requirement, Air flow to passenger compartment, Duct for air conditioning, cooling of transverse engine and rear engine.

2. Shape optimization of Cars -

2.1 - Front end modification, Front and rear wind shield angle, Dust flow patterns at the rear.

2.2 - Effects of gap configuration, Effects of fasteners, Wind Noise, Drag resistance in commercial vehicles.

3. Design of Cylinder and Piston -

3.1 - Choice of material for cylinder and piston, Piston friction, Piston slap.

3.2 - Design of cylinder, Piston pin, Piston rings.

3.3 - Piston failures, Lubrication of piston assembly.

4. Design of Connecting Rod and Crankshaft -

4.1 - Material for connecting rod, Determining minimum length of connecting rod, small end and big end design.

4.2 - Material for crankshaft, Design of crank shaft under bending and twisting, Balancing weight calculations.

5. Design of Valves and Flywheel -

5.1 - Design aspect of intake and exhaust manifolds, Inlet and exhaust valves.

5.2 - Valve springs, Tappets, Valve train, Materials and design of flywheel.

6. Design of Clutch -

6.1 - Design of single plate clutch, Multiplate clutch.

6.2 - Energy dissipated, design of clutch components.

7. Design of Gear Box -

7.1 - Performance of vehicle, Total resistance to motion, Traction and tractive effort, Acceleration, Calculation of gear ratios.

7.2 - Design of three speed gear box, Design of four speed gear box.

8. Design of Final Drive and Rear Axle -

8.1 - Design of propeller shaft, Design details of final drive gearing.

8.2 - Design details of Full floating, Semi floating and Three quarter floating rear shafts and rear axle housing.

9. Design of Springs -

9.1 - Design of coil spring.

9.2 - Design of leaf spring.

10. Design of Brakes -

10.1 - Design of drum brakes.

10.2 - Design of disc brakes.

Subject : Aerodynamics and Design Lab
Subject Code : AUT610

List of Practical:-

1. On a drawing sheet design cylinder and piston. Prepare drawing indicating overall dimensions, tolerances, hardness and finish.
2. On a drawing sheet design connecting rod and crankshaft. Prepare drawing indicating overall dimensions, tolerances, hardness and finish.
3. On a drawing sheet design valves and flywheel. Prepare drawing indicating overall dimensions, tolerances, hardness and finish.
4. On a drawing sheet design single plate clutch. Prepare drawing indicating overall dimensions, tolerances, hardness and finish.
5. On a drawing sheet design a three speed gear box. Prepare drawing indicating overall dimensions, tolerances, hardness and finish.
6. On a drawing sheet design final drive. Prepare drawing indicating overall dimensions, tolerances, hardness and finish.
7. On a drawing sheet design rear axle. Prepare drawing indicating overall dimensions, tolerances, hardness and finish.
8. On a drawing sheet design coil spring and leaf spring. Prepare drawing indicating overall dimensions, tolerances, hardness and finish.
9. On a drawing sheet design drum brake. Prepare drawing indicating overall dimensions, tolerances, hardness and finish.
10. On a drawing sheet design disc brake. Prepare drawing indicating overall dimensions, tolerances, hardness and finish.

Book:

Sl. No.	Author	Title	Publication
1	R.K.Jain	Machine Design	Khanna Publication
2	R.S. Khurmi & J. K. Gupta	Machine Design	Eurasia Pub. Hours
3	Pandya & Shah	Machine Design	Dhanpat Rai & Sons
4	P.C. Sharma & D.K. Aggarwal	Machine Design	S.K. Kataria & Sons
5	R.B. Gupta	Auto Design	Satya Prakashan
6	N.K. Giri	Problm in Auto Engg.	Khanna Publication
7	K. M. Aggarwal	Auto Design Problem	Saty Praksahan

Subject : Mechatronics (Elective-II)
Subject Code : MEC607
Full Marks : 80+20=100
Hours : 42

RATIONALE:

The integration of electronics engineering, electrical engineering, computer technology and control engineering with mechanical engineering is increasingly forming a crucial part in the design, manufacture and maintenance of wide range of engineering products and processes. As a consequence there is a need for a diploma engineers to understand systems used in automation

OBJECTIVES:

Students should be able to:

1. Identify various input and output devices in an automated system.
2. Understand and draw ladder diagrams.
3. Write simple programs for PLCs.
4. Interpret and use operations manual of a PLC manufacturer.
5. Use simulation software provided with the PLC.
6. Understand interfacing of input and output device

CONTENTS: Theory

Chapter	Name of the Topic	Hours
1	Introduction to Sensors, Transducers and Actuators Principle, working and applications of-Limit switches, proximity switches like inductive, capacitive and optical (deflecting and through beam type), Thumb wheel switches, magnetic reed switches, Optical encoders-displacement measurement, rotary, incremental, opto-couplers. Actuator – solenoids – on-off applications, latching, triggering Types of relays- solid state Types of motors – DC motors, DC brushless motors, AC Motors, stepper motors, servo motors.	06

2	<p>8085 Microprocessor</p> <p>Architecture, Pin configuration, working of microprocessor, and applications. Instructions and simple programmes.</p> <p>Introduction to ICs used for interfacing such as–Programmable peripheral devices, USART, memory, keyboard, display – LCD,LED,I/O device, ADC, DAC etc</p> <p>8051 Microcontroller</p> <p>Architecture, Pin configuration, working of microcontroller, Applications. Comparison of microprocessor and microcontroller, advantages and disadvantages</p>	08
3	<p>Programmable Logic Controller (PLC)</p> <p>Introduction, PLC definition, PLC block diagram, Difference between relay panel and PLC, ,power supply, input/output modules (analog, digital) concepts of sink/source, set/reset, latch/unlatch, advantages and disadvantages, installation , troubleshooting and maintenance</p>	08
4	<p>Selection of a PLC Programming equipment, Programming formats</p> <p>Ladder diagrams and sequence listing, large process ladder diagram construction, flowcharting as a programming method, Basic PLC functions, Register basics, timer functions, counter functions, Intermediate functions – Arithmetic functions, number comparison and number conversion functions.</p> <p>Data handling functions- SKIP, Master control relay, Jump, Move, Block move, Table to register and register to table move functions. FIFO and LIFO functions, File Arithmetic and Logic function.</p>	12
5	<p>ONS and CLR functions and their applications PLC digital bit functions and applications Sequencer functions and cascading of sequencers PLC matrix functions</p> <p>Discrete and analog operation of PLC, Networking of PLCs. PLC auxiliary commands and functions,</p>	06
6	<p>Online, offline, stop/run modes of operations, uploading/downloading between PLC and PC, Introduction to SCADA and DCS</p>	02
Total		42

Subject : Mechatronics Lab (Elective-II)
Subject Code : MEC614

List of Practical:

Term work shall consist of detailed report on the following experiments:

1. Identification and demonstration of different sensors and actuators.
2. Programme of addition and subtraction using 8085 microprocessor.
3. Programme of BCD operation 8085 microprocessor.
4. Study of PLC and execution of simple commands.
5. Demonstration of the working of various digital to analog and analog to digital converters.
6. Development of ladder diagram, programming using PLC for
 - a) Measurement of speed of a motor
 - b) Motor start and stop by using two different sensors
 - c) Simulation of a pedestrian traffic controller
7. Execution of programmes for
 - a) Simulation of four road junction traffic controller
 - b) Lift / elevator control
 - c) Washing machine control
 - d) Tank level control
8. Trace, interpret and demonstrate working of at least two electro pneumatic systems.
9. Trace, interpret and demonstrate working of at least two electro hydraulic systems.
10. Descriptive study of option available in SCADA & DCS.

Learning Resources: Books:

Sr. No.	Author	Title	Publication
1	Bolton W.	Mechatronics- Electronic control systems in Mechanical and Electrical Engineering	Pearson Education Ltd.
2	Histand B.H. and	Introduction to Mechatronics and	Tata McGraw Hill
3	John W. Webb and Ronald Reis	Programmable Logic Controllers	Prentice Hall of
4	NIIT	Programmable Logic Control – Principles and Applications	Prentice Hall of
5	Kolk R.A. and Shetty D.	Mechatronics systems design	Vikas Publishing, New Delhi
6	Mahalik N.P.	Mechatronics principles, concepts and applications	Tata McGraw Hill Publishing

Subject : Automobile Air-Conditioning (Elective-I)
Subject Code : AUT607
Hours : 42
Full Marks : 80+20=100

1. Introduction (5 Hrs)

- 1.1. Environmental & safety aspects in heating, ventilation & air-conditioning systems
- 1.2. Human comfort control- comfort zone, air movement, wind chill factor, odour problems & effect of humidity.
- 1.3. Heat transfer fundamentals, Requirements of heating, ventilation & air conditioning in cars, multi utility vehicles, heavy passenger vehicles, coaches & cryogenic substances.
- 1.4. Controlled & uncontrolled ventilation- Working, application & comparison.

2. Comfort heating system& heat load (4 Hrs)

- 2.1 Function, construction, working, maintenance, general faults & their remedies of
Comfort Heating System, Plain heating, Electric heating, steam heating, hot water Heating, solar heating.
- 2.2 Heating with humidification & heating with dehumidification.
- 2.3 Gain load, air change load, product load & miscellaneous load (no numerical), concept of Sensible Heat Factor, RSHF, GSHF.

3. Case & Duct System (5 hrs)

- 3.1 Construction & Working of Air Intake Section, core section & distribution section.
- 3.2 Construction & working of Downstream, upstream, split & hybrid.
- 3.3 Construction & working of rear heating & cooling system.

4. Basic concept of Refrigeration system (6 Hrs)

- 4.1 Definitions of refrigeration, air-conditioning, ton of refrigeration, COP, expression of COP of ideal refrigerator/heat pump, enthalpy, entropy.
- 4.2 Types of refrigeration System
 - 4.2.1. Vapour compression refrigeration system (VCRS)- components, operation, T-S & P-H diagram, effect of superheating & under-cooling of refrigerant (simple numerical)
 - 4.2.2. Vapour absorption refrigeration system (simple & practical ammonia-water systems only)—components, operation, T-S & P-H diagram, comparison with VCRS (simple numerical)
 - 4.2.3. Air Refrigeration System—components, operation & applications.

5. Air Conditioning System (10 Hrs)

- 5.1 General layout of Air conditioning system.
- 5.2 Construction & working of following refrigeration sub systems thermostatic expansion valve,

fixed orifice tube & rotary vane air cycle system.

5.3 Construction & working of evaporator, condenser, accumulator.

5.4 Receiver driers & accumulator- Types, construction & working

5.5 Construction & working of reciprocating, scroll & rotary vane compressors. Drive systems for compressors

5.6 Construction & working of electromagnetic clutch

5.7 Metering devices- comparison of thermostatic expansion valve & fixed orifice tube.

Types working & comparison of thermostatic expansion valves i.e. valve, block type, internally equalized & externally equalized.

5.8 Functions of thermostatic expansion valve i.e. throttling action, modulating action & controlling action. Construction & working of remote bulb.

6. System control devices & electrical circuits (8 Hrs)

- 6.1 System controls- Construction & working of typical vacuum system & electronic temperature control system.
- 6.2 Construction & working of vacuum operated devices i.e. vacuum reserve tank, vacuum restrictor, vacuum motor, check valve & check relays.
- 6.3 Switches-Construction & working of high-side temperature switch, low-side temperature switch, high- pressure switch, low-pressure switch, pressure regulator, ambient switch & super heat switch.
- 6.4 Sensors-Construction & working of sun load sensor, outside temperature sensor & in car temperature sensors.
- 6.5 Construction & working of Aspirator.
- 6.6 Construction & working of blower clutch control, heater control, and time delay relay for heater control.
- 6.7 Mode doors and temperature doors.
- 6.8 Electrical circuits- Typical climate control system & Electronic climate control system, their electrical circuits & working.

7. Repairs & maintenance of Air Conditioning system (10 Hrs)

- 7.1 Visual & acoustic check, side glass, leak test, temperature test, Procedure of charging & discharging. Moisture removal procedure.
- 7.2 Service equipments & tools–Vacuum pump, Manifold & gauge i.e. Low side & high side, gauge calibration, recovery unit & recycling unit, Halide (Freon) & Fluorescent leak detector, nitrogen leak test
- 7.3 Compressor service-Symptoms, faults, cause remedy.
- 7.4 Electromagnetic clutch service-Symptoms, faults, cause & remedy.
- 7.5 Performance testing procedure of thermostatic expansion valve & fixed orifice tube.
- 7.6 Refrigerant lubricants- Properties & types
- 7.7 Refrigerant- types, Packaging, storage, restrictions, color code & purity test
- 7.8 Hoses & connectors– construction of system hoses, charging hose with shut off valve & connectors. Retrofitting from CFC-R12 to HFC-134A–need, procedure & Precautions

Subject : Automobile Air-Conditioning Lab (Elective-I)
Subject Code : AUT612

List of Practical:-

1. Demonstration of all parts of all sub systems and assembly and disassembly of three different types of compressors.
2. Identification and use of tools, gauges and equipment for servicing.
3. Demonstration of charging and evacuation of refrigerant from system.
4. Demonstration of leakage testing using soap solution and other techniques.
5. Diagnosis of electrical system faults.
6. Diagnosis of control system faults.
7. Perform lubrication of A.C system.
8. Perform servicing of heating system.
9. Retrofitting from CFC-R 12 to HFC- 134A.
10. Diagnosis of various running faults in car HVAC.

Learning Resources:

1. Basic Refrigeration & air-conditioning—P.N.ANATHANARAYANAN (TMH)
2. Automobile Air Conditioning—BOYCE H. DWIGGINS (Thomson Learning)

Subject : Vehicle Maintenance (Elective-II)
Subject Code : AUT608
Full Marks : 80+20=100
Hours : 42

1. Auto Workshop Safety -

- 1.1- Safety in the shop, Shop layout, Hazards and how to avoid them, Hazards due to faulty work habits or conditions, Hazards due to equipment defects or misuse, Hand tool hazards, Fire prevention, Fire extinguisher.
- 1.2 - Shop safety rules, Hazardous materials, Hand protection, Driving cars in the shop, Personal protective equipments.

2. Auto Workshop Equipments -

- 2.1- Hydraulic lift, Hydraulic press, Vehicle washers, Battery charger, Engine analyzer, Wheel balancing machine, Turning Radius Gauge, Camber-Castor- King pin gauge, Toe in gauge.
- 2.2- Wheel aligning equipment, Tyre changer, Head light beam aligner, Four post hoist, Hydraulic hoist, Workshop crane, Layout of workshop.

3. Maintenance Management and Maintenance of Engines -

- 3.1- Maintenance management and record keeping, Types of maintenance, Maintenance schedules, Job or Repair order.
- 3.2- Engine maintenance- Cleanliness, Oil and filter, Air filter, Coolant level, Brake fluid, Drive test.
- 3.3- Dismounting the engine, Engine Disassembly, Troubleshooting of an engine.

4. Diagnosis and Servicing of Cooling System -

- 4.1- Working safely on the cooling system, Diagnosing cooling system troubles, Cause of coolant loss, Causes of engine overheating, Causes of slow warm up.
- 4.2 Checking coolant level, Testing antifreeze strength, Testing the thermostat, Checking hoses and connections, Checking for exhaust gas leakage into cooling system, Pressure testing the cooling system, Pressure testing the radiator cap, Testing the drive belt.
- 4.3- Cleaning the cooling system, Bleeding the cooling system, Locating and repairing radiator leaks, Water pump service, Replacing expansion core plugs.

5. Diagnosis and Servicing of Engine -

- 5.1 - Care and cleanliness, Cylinder head and valve service, Valve troubles, Valve sticking, Valve burning, Valve breakage, Valve face wear, Valve seat recession, Valve deposits, Valve adjustments, Adjusting valves on solid lifter OHV engines, Adjusting hydraulic valve lifters on OHV engines, Adjusting valves on OHC engines, Jet valve adjustment, Complete valve service, Cylinder head service, Rocker arm stud service, Rocker arm service, Push rod service, Valve spring inspection, Valve guide service, Valve cleaning and inspection, Valve service, Valve seat service, Cam shaft service, Valve lifter service, Valve installation, Cylinder head installation, Intake manifold installation.
- 5.2- Preparing to remove pistons and rings, Removing piston and rod assemblies, Separating pistons and rods, Checking connecting rods, Inspecting connecting rod bearings, Inspecting connecting rod journals, Piston service, Piston ring service, Installing connecting rod bearings, Installing piston and rod assemblies, Checking connecting rod bearing clearance, Checking connecting rod side clearance.
- 5.3- Engine short block, Engine mount service, Engine removal, Crank shaft and main bearing service, Removing main bearing caps, Inspecting main bearings, Checking crankshaft journals, Checking main bearing clearance, Checking crankshaft endplay, Replacing main bearings, Replacing thrust bearing,

Removing the crankshaft, Checking the crankshaft, Cleaning the crankshaft, Cylinder block inspection, Cylinder block cleaning, Cylinder service, Refinishing cylinders, Cleaning cylinders, Installing cylinder liners.

- 5.4- Tuning of engine- Introduction, Engine tune up, Tune up procedure, Tune up instruments, Types of tune up, Trouble shooting of engine.

6. Diagnosis and Servicing of Fuel Supply and Lubrication System -

- 6.1- Petrol fuel injected system- Fuel system safety cautions, Fuel system visual inspection, Checking fuel injectors, Causes of inoperative fuel pump, Resetting inertia switch, Testing fuel pump pressure and capacity, Testing fuel pressure regulator, Testing fuel injectors, The role of on board diagnostics, Monitored and non-monitored circuits, Retrieving trouble codes, Interpreting trouble codes and scan data, Sensor diagnosis, ECM diagnosis, Servicing the fuel system, Air cleaner service, Fuel filter service, Fuel gauge service, Cleaning fuel injectors, Cleaning throttle body, Throttle body injection service, Port injection service, Trouble shooting of petrol fuel injected system .
- 6.2 - Diesel fuel injected system- Diesel fuel system trouble diagnosis, Fuel system visual inspection, Checking fuel injectors, Causes of inoperative fuel pump, Testing fuel pump pressure and capacity, Testing fuel pressure regulator, Testing fuel injectors, Servicing the fuel system, Air cleaner service, Fuel filter service, Fuel gauge service, Cleaning fuel injectors, Trouble shooting of diesel fuel injected system .
- 6.3- Lubricating system troubles, Oil consumption, Oil pressure light or gauge shows low pressure, Servicing lubricating system, Oil pan service, Oil pump service, Pressure relief valve service, Oil pressure indicators service, Trouble shooting of lubrication system.

7. Diagnosis and Servicing of Clutch, Gear Box and Drive Line -

- 7.1- Clutch troubles, Identifying clutch system bearing noise, Servicing the clutch, Clutch linkage adjustment, Checking for clutch disengagement, Checking clutch pedal free travel, Bleeding clutch hydraulic system, Clutch removal, Inspecting and servicing clutch parts, Clutch installation, Trouble shooting of clutch.
- 7.2- Manual transmission and transaxle trouble diagnosis, Types of manual transmission and transaxle troubles, Manual transmission troubles, Manual transaxle troubles, Manual transmission maintenance, Manual transmission removal, Manual transmission disassembly and cleaning, Inspecting manual transmission parts, Manual transmission assembly, Manual transmission installation, Manual transaxle maintenance, Manual transaxle service, Manual transaxle removal, Manual transaxle overhaul, Manual transaxle installation.
- 7.3- Drive shaft and universal joint trouble diagnosis, Drive shaft and universal joint service, CV joint and half shaft trouble diagnosis, CV joint boot inspection, CV joint boot service, Drive axle trouble diagnosis, Drive axle and differential service, Servicing the differential assembly, Servicing limited slip differentials, Trouble shooting of drive line.

8. Diagnosis and Servicing of Braking System -

- 8.1 Caution for working around brake dust, Diagnosing drum brake troubles, Caliper service, Servicing brake disc, Flushing the non ABS hydraulic system.

9. Diagnosis and Servicing of Suspension System -

- 9.1- Suspension system maintenance and trouble shooting, Inspection and service of suspension system, Trouble shooting of suspension system.

10. Diagnosis and Servicing of Wheels and Tyres -

- 10.1- Wheel run out, Wheel balance, Tyre repair, Tubeless tyre repair, Wheel repair, Cautions for servicing tyres, Checking tyre pressure and inflating tyres, Tyre inspection.
- 10.2- Removing wheels from the vehicle, Tyre rotation, Dismounting the tyre from the rim, Wheel inspection, Replacing tyre valves, Mounting the tyre on the rim, Installing the wheel on the rim.

Subject : Vehicle Maintenance Lab (Elective-II)
Subject Code : AUT613

List of Practical:-

1. In a automatic tyre changer, dismount the tyre from the wheel and then mount the tyre again on the wheel.
2. In a given engine perform the following task:-
 - a. Measure the engine oil level.
 - b. Replace the lubricating oil filter.
 - c. Replace the engine oil.
 - d. Clean the oil filter.
 - e. Replace the fuel filters.
3. In a given engine perform the following task :-
 - a. Check the coolant level.
 - b. Pressure test the cooling system.
 - c. Pressure test the radiator cap.
 - d. Test the drive belt tension.
 - e. Replace the coolant.
4. In a given engine perform the following task :-
 - a. Measure and note the clearance of inlet and exhaust valves.
 - b. Set the valve clearances according to manufacturer's specification.
 - c. With a torque wrench tighten the stud nuts of cylinder block and cylinder head in correct procedure and according to manufacturer's specification.
5. In a given engine perform the following task :-
 - a. Measure and note the spark plug gap.
 - b. Set the gap according to manufacturer's specification..
 - c. Clean and test fuel injectors.
6. In a given vehicle perform the following task :-
 - a. Bleed hydraulic clutch system.
 - b. Replace clutch plate.
 - c. Note clutch free pedal play.
 - d. Adjust clutch free pedal play according to manufacturer's specification.
7. In a given vehicle perform the following task :-
 - a. Replace gear oil.
 - b. Lubricate sliding joint and universal joint.

c. Replace differential oil.

8. In a given vehicle perform the following task :-

a. Replace brake pads of front wheels.

b. Replace brake shoe of rear wheels.

c. Bleed hydraulic brake system.

9. In a given vehicle perform the following task:-

a. Replace any wheel with spare wheel.

b. Perform tyre rotation.

c. Measure and note tyre pressure of each wheel.

d. Set tyre pressure according to manufacturer's specification.

10. In a given vehicle perform all the task provided in the periodic maintenance chart.

Books:

Sr. No.	Author	Title	Publisher
1	Kirpal Singh	Automobile Engineering Vol. I & II	Standard Publication
2	Anthony Schwaller	Motor automotive technology	Delmar Publisher Inc.
3	Tim Gills	Automotive service	Delmar Publisher Inc.
4	Anil Chikkara	Automobile Engineering Vol. I & II	Satya Prakashan New Delhi
5	Crouse/Anglin.	Automobile Mechanics	TATAMc Graw-HILL
6	Harbans Singh Royat	TheAutomobile	S. Chand Publication
7	R.B. Gupta	Automobile Engineering	Satya Prakashan New Delhi
8	S. Srinivisan	Automotive Mechanics	TATA McGraw-HILL
9	HMSETHI	Automotive Technology	TATA McGraw-HILL

Subject : Alternative Source Energy (Elective-II)
Subject Code : MEC610
Full Marks : 80+20=100
Hours : 42

Content-

1. Introduction to Energy Sources

- 1.1 Introduction.
- 1.2 Major sources of energy: Renewable and Non-renewable.
- 1.3 Primary and secondary energy sources.
- 1.4 Energy Scenario:
 - Prospects of alternate energy sources.
 - Need of Alternate energy sources.

2. Solar Energy

- 2.1 Principle of conversion of solar energy into heat and electricity
- 2.2 Solar Radiation: Solar Radiations at earth's surface
 - Solar Radiation Geometry: Declination, hour angle, altitude angle, incident angle, zenith angle, solar azimuth angle
- 2.3 Applications of Solar energy: -
 - Construction and working of typical flat plate collector and solar concentrating collectors and their applications,
 - Advantages and limitations
 - Space heating and cooling.
 - Photovoltaic electric conversion.
 - Solar distillation, Solar cooking and furnace.
 - Solar pumping and Green House.
 - Agriculture-Solar drying for foods
 - (no derivations and numerical)

3. Wind Energy

- 3.1 Basic Principle of wind energy conversion.
- 3.2 Power in wind, Available wind power formulation, Power coefficient, Maximum power
- 3.3 Main considerations in selecting a site for wind mills.
 - Advantages and limitations of wind energy conversion.
- 3.4 Classification of wind mills
 - Working of horizontal and vertical axis wind mills, their comparison
 - Main applications of wind energy for power generation and pumping.

4. Energy from Biomass

- 4.1 Common species recommended for biomass.
 - Methods for obtaining energy from biomass
- 4.2 Thermal classification of biomass
 - Gasifier,
 - Fixed bed and fluidized
 - Application of gasifier
- 4.3 Biodiesel properties, production and application
- 4.4 Agriculture waste as a biomass
 - Biomass digester
 - Comparison of Biomass with conventional fuels

5. Energy Conservation & Management

- 5.1 Energy scenario in various sectors and Indian economy
- 5.2 Need and importance of energy conservation and management
- 5.3 Concept of Payback period, Return on investment (ROI), Life cycle cost, Sankey diagrams, specific energy consumption.

6. Energy Conservation Techniques

- 6.1 Distribution of energy consumption
 - Principles of energy conservation.
 - Energy audit
 - Types of audit
- 6.2 Methods of energy conservation
 - Cogeneration and its application
 - Combined cycle system
- 6.3 Concept of energy management
- 6.4 Study of different energy management techniques like
 - Analysis of input
 - Reuse and recycling of waste
 - Energy education
 - Conservative technique and energy audit

7. Economic approach of Energy Conservation

- 7.1 Costing of utilities like steam, compressed air, electricity and water.
 - Ways of improving boiler efficiency
- 7.2 Thermal insulation, Critical thickness of insulation
- 7.3 Waste heat recovery systems, their applications, criteria for installing unit.
- 7.4 An introductory approach of energy conservation in compressed air, refrigeration, air conditioning, pumps and fans.

Subject : Alternative Source Energy Lab (Elective-II)
Subject Code : MEC617

List of Practical's-

- 1) To collect information about global and Indian energy market.
- 2) To perform an experiment on solar flat plate collector used for water heating.
- 3) To study and analyze performance of Solar street lighting System.
- 4) To study construction and working of photo voltaic cell.
- 5) To study construction, working and maintenance of solar cooker.
- 6) Visit to plant of solar heating system for hotel/hostel/railway station etc.
- 7) To study construction and working of horizontal axis wind mill or to visit a nearest wind farm.
- 8) To visit a biomass/ biogas plant of municipal waste or elsewhere.
- 9) Perform energy audit for workshop/Office/Home/SSI unit.
- 10) Study of various waste heat recovery devices.

Books:

Author	Title	Publication
Dr B.H.Khan	Non conventional energy Resources	Tata McGraw Hill
G. D. Rai	Non conventional energy sources	Khanna publication
S. P. Sukhatme	Solar energy	Tata McGraw Hill
H. P. Garg	Solar energy	Tata McGraw Hill
Arrora Domkundwar	Power plant engineering	Dhanpat Rai & co.
P.H. Henderson	India- The energy sector	University Press
D. A. Ray	Industrial energy conservation	Pergaman Press
W. C. Turner	Energy management handbook	Wiley Press
K. M. Mittal	Non-conventional energy source	--
Krupal Singh Jogi	Energy resource management	Sarup and sons

Subject : Professional Practices (Common Paper)
Subject Code : 602

Rationale:

Most of the diploma holders join industries. Due to globalization and competition in the industrial and service sectors the selection for the job is based on campus interviews or competitive tests.

While selecting candidates a normal practice adopted is to see general confidence, ability to communicate and attitude, in addition to basic technological concepts.

The purpose of introducing professional practices is to provide opportunity to students to undergo activities which will enable them to develop confidence. Industrial visits, expert lectures, seminars on technical topics and group discussion are planned in a semester so that there will be increased participation of students in learning process.

Activities to be undertaken:

Students are expected to undertake these activities:

1. Acquire information from different sources (Print and electronic) on the topics of specialization and related to the subjects of II nd and final year. The class is to be divided in groups of not more than five to six students in a group and all groups are to be allotted topic of their choice. The topic should not be repeated to other group for originality of work to be performed by the group. This activity will develop interdependence and leadership among the students.
2. Prepare notes for given topic at point no 1. The notes will be in form of a project report, having all the sections of report. The report should not be of 30 – 50 pages.
3. Prepare presentation and Present the learning and finding on given topic in a seminar. The presentation should be prepared in Power Point module having more than 25 slides. All students should be asked to deal with suitable parts decided by the group itself.
4. Interact with peers to share thoughts. After the final presentation the students should be encouraged to interact with the faculty members, students' fellows and other experts for suggestions and advanced and structured learning.
5. Undertake industrial visit of their area and choice. Prepare a report on industrial visit. Expert lectures on the topic selected may be invited for the students and these expert lectures also the students should be asked to prepare a report and present the same in seminar or have a group discussion before the expert and faculty members.
6. Develop entrepreneurial traits. Students group may be asked to have a field survey and product assessment and analysis for a product of their choice. Prepare a report for all the inputs of their requirement and submit it for evaluation.
7. To prepare for start ups. Expert lectures for exploring this option may be arranged as this is also a viable option and much talked about option for self employment and avail the encouragement by the government.

Based on the above rationales students will advised to develop traits under guidance of dedicated faculty members / mentors.