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

STUDY & EVALUATION SCHEME WITH SYLLABUS

FOR

B. TECH 4th YEAR
AUTOMOBILE ENGINEERING

ON

CHOICE BASED CREDIT SYSTEM

(EFFECTIVE FROM THE SESSION: 2019-20)
### SEVENTH SEMESTER

<table>
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<th>Sl.No.</th>
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<th>Department</th>
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<th>Sessional</th>
<th>Total</th>
<th>Credit</th>
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**DEPARTMENTAL ELECTIVE-3**

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<tr>
<td>RAU070</td>
<td>Automotive Electrical &amp; Electronic System</td>
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<td>RAU071</td>
<td>Advanced Automobile Technologies</td>
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<td>RAU072</td>
<td>Project Management</td>
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<td>RME073</td>
<td>Additive Manufacturing</td>
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**DEPARTMENTAL ELECTIVE-4**

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<td>Automotive Transmission</td>
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<td>RAU076</td>
<td>Tractors and Earth Moving Equipment’s</td>
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<td>RME077</td>
<td>Computational Fluid Dynamics</td>
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<td>RME078</td>
<td>Automation &amp; Robotics</td>
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- Students who was not-place in any company, it is mandatory to select any one subject from DE-5 & 6.
- Students who was place in any company, it is mandatory to select MOOC subject in both DE-5 & 6.

### EIGHT SEMESTER

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<th>Sl.No.</th>
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<td>RAU080</td>
<td>Automotive Pollution and Control</td>
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<td>RAU081</td>
<td>Noise, Vibration and Harness</td>
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<td>RAU082</td>
<td>Alternate Energy Sources for Automobiles</td>
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<td>RAU083</td>
<td>Material Handling Equipment’s</td>
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**DEPARTMENTAL ELECTIVE-6**

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<td>RAU085</td>
<td>Vehicle Body Engineering and Safety</td>
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<td>RAU086</td>
<td>Trouble Shooting, Service &amp; Maintenance Repair</td>
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<td>RME087</td>
<td>Design &amp; Transmission System</td>
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<td>RAU087</td>
<td>Automotive Air Conditioning</td>
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**OR**

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<td>RAU088</td>
<td>Design for Quality, Manufacturing and Assembly.</td>
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SEMESTER-VII
UNIT-I:
Principles of Computer Graphics:
Point plotting, drawing of lines, Bresenham’s circle algorithm.

Transformation in Graphics:
Co-ordinate system used in Graphics and windowing, view port, views.
2D transformations – rotation, scaling, translation, mirror, reflection, shear - homogeneous transformations – concatenation.
3D Transformation – Perspective Projection – Technique (Description of techniques only).

Geometric Modelling:
Design of curved shapes- Cubic spline – Bezier curve – B-spline – Design of Surfaces - features of Surface Modelling Package – Solid Primitives, CSG.
B-rep and description of other modelling techniques like Pure primitive instancing, cell decomposition, spatial occupancy enumeration, Boolean Operations (join, cut, intersection), Creating 3D objects from 2D profiles (extrusion, revolving etc).

UNIT-II:
Graphics standard & Data storage:
Standards for computer graphics GKS, PHIGS. Data exchange standards – IGES, STEP - Manipulation of the model - Model storage.

Finite Element Modelling:
Introduction, Mesh Generation – mesh requirements.
Fully Automatic Methods- Element-based approach, Application, Mesh Refinements using Isoperimetric Finite Elements, Meshing in high gradient areas, Transition Regions. Sub modelling Concept.
An overview of modelling software’s like PRO-E, CATIA, IDEAS, SOLID EDGE etc.

UNIT-III:
CAM:
Scope and applications – NC in CAM – Principal types of CNC machine tools and there construction features – tooling for CNC – ISO designation for tooling – CNC operating system – FANUC, SINUMERIK – LINUMERIK.
Programming for CNC machining – coordinate systems – manual part programming – computer assisted part programming – CNC part programming with CAD system.

Material handling in CAM environment:
Types – AGVS – AS/RS – Swarf handling and disposal of wastes – single and mixed mode assembly lines – quantitative analysis of assembly systems.

UNIT-IV:
Robotics:

Quality Function Deployment:
UNIT-V:

Rapid prototyping:
Need for rapid prototyping, Basic principles and advantages of RP, General features and classifications of different RP techniques with examples.
Introduction to three representative RP techniques: Fusion Deposition Modelling, Laminated Object Manufacturing and Stereo-lithography.

Flexible manufacturing cells:

Books and References:
UNIT-I:
Clutch and gear box:
Requirement of transmission system, Different types of clutches, principle & Construction of Single plate coil spring and Diaphragm spring clutches., Need and Objectives of Gear box. Construction and operation of Sliding mesh, Constant mesh and Synchronmesh gearboxes. – Determination of gear ratios for vehicles. Performance characteristics in different speeds. Problems on performance of automobile such as Resistance to motion, Tractive effort, Engine speed & Power and acceleration.

UNIT-II:
Hydrodynamic transmission:

UNIT-III:
Epicyclic gearboxes used in automatic transmission:

UNIT-IV:
Automatic transmission applications:
Need for automatic transmission, Four speed longitudinally mounted automatic transmission – Chevrolet “Turboglide” Transmission, Continuously Variable Transmission (CVT) – Types – Operations of a typical CVT.

UNIT-V:
Hydrostatic and electric drive:

Books and References:
COMPUTER AIDED DESIGN & MANUFACTURING LAB

List of Experiments: (Total EIGHT Experiments are to carried out. FOUR Experiments each from CAD and CAM.)

A. CAD Experiments:
1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modelling Software commands.
6. Writing a small program for FEM for 2 spring system and validation of program or using a FEM Package.
7. Root findings or curve fitting experiment: Writing and validation of computer program.
8. Numerical differentiation or numerical integration experiment: Writing and validation of computer program.

B. CAM Experiments:
1. To study the characteristic features of CNC machine.
2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine.
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine.
4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine.
5. Experiment on Robot and programs.
6. Experiment on Transfer line/Material handling.
7. Experiment on difference between ordinary and NC machine, study or retrofitting.
8. Experiment on study of system devices such as motors and feedback devices.
9. Experiment on Mechatronics and controls.
List of Experiments: (At least 8 experiments out of following in depth and details.)

1. Performance Analysis of Four stroke S.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
2. Determination of Indicated H.P. of I.C. Engine by Morse Test.
4. Study & experiment on Valve mechanism.
5. Study & experiment on Gear Box.
6. Study & experiment on Differential Gear Mechanism of Rear Axle.
7. Study & experiment on Steering Mechanism.
8. Study & experiment on Automobile Braking System.
9. Study & experiment on Chassis and Suspension System.
10. Study & experiment on Ignition system of I.C. Engine.
11. Study & experiment on Fuel Supply System of S.I. Engines- Carburettor, Fuel Injection Pump and MPFI.
13. Study & experiment on Air Conditioning System of an Automobile.
14. Study and testing of NO\textsubscript{x} emission.
15. Study and testing of SO\textsubscript{x} emission.
16. Study and testing of CO emission.
17. Experiment on Engine Tuning.
18. Experiment on Exhaust Gas Analysis of an I.C. Engine.
DEPARTMENTAL ELECTIVE-3
AUTOMOTIVE ELECTRICAL & ELECTRONICS SYSTEM

UNIT-I:
Batteries and accessories:
Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on batteries, maintenance and charging.

Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn, wiper system and trifactor.

UNIT-II:
Starting system:
Condition at starting, behaviour of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, care and maintenances of starter motor, starter switches.

UNIT-III:
Charging system:
Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cut-out. Voltage and current regulators, compensated voltage regulator, alternators principle and constructional aspects and bridge rectifiers, new developments.

UNIT-IV:
Fundamentals of automotive electronics:
Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system.

UNIT-V:
Sensors and activators:
Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors, relay.

Books & references:
UNIT-I: 
Project Management Concepts: 
Introduction, project characteristics, taxonomy of projects, project identification and formulation. Establishing the project and goals. 
Nature & context of project management; phases of PM, A framework for PM issues, PM as a conversion process, project environment & complexity. Organizing human resources, organizing systems & procedures for implementation. Project direction.

UNIT-II: 
Project Organization & Project Contracts: 
Introduction, functional organization, project organization, matrix organization, modified matrix organization. 
Pure project organization, selection of project organization structure, project breakdown structures, project contracts, types of contracts, types of payments to contractors.

UNIT-III: 
Project Appraisal & Cost Estimation: 
Introduction, technical appraisal, commercial appraisal, economic appraisal, financial appraisal, management appraisal, social cost/benefit analysis, project risk analysis. 
Cost analysis of the project, components of capital cost of a project, modern approach to project performance analysis.

UNIT-IV: 
Project Planning & Scheduling: 
Introduction to PERT & CPM, planning and scheduling networks, time estimation, determination of critical path, CPM model, event slacks & floats, PERT model. Expected time for activities, expected length of critical path, calculating the project length and variance, PERT & CPM cost accounting systems, lowest cost schedule, crashing of networks, linear programming formulation of event-oriented networks, updating of networks, LOB technique.

UNIT-V: 
Modification & Extensions of Network Models: 
Complexity of project scheduling with limited resources, resource levelling of project schedules, resource allocation in project scheduling - heuristic solution. Precedence networking- examples with algorithm, decision networks, probabilistic networks, computer aided project management essential requirements of PM software, software packages for CPM. Enterprise- wide PM, using spread sheets for financial projections.

Books and References: 
1. Project Management by Harvey Maylor, Pearson India. 
5. Project Management: A Life Cycle Approach by Kanda, PHI, India. 
UNIT-I:
Overview of AM:
History and Advantages of Additive Manufacturing, Distinction Between Additive Manufacturing and CNC Machining, Types of Additive Manufacturing Technologies, Nomenclature of AM Machines.

Direct and Indirect Processes:
Prototyping, Manufacturing and Tooling.

Layer Manufacturing Processes:
Polymerization, Sintering and Melting, Extrusion, Powder-Binder Bonding, Layer Laminate Manufacturing, Other Processes; Aerosol printing and Bio plotter.

UNIT-II:
Development of Additive Manufacturing Technology:
Computer Aided Design Technology, Other Associated Technology, Metal and Hybrid Systems. Generalized Additive Manufacturing Process Chain; The Eight Steps in Additive Manufacturing, Variation from one AM Machine to Another, Metal System, Maintenance of Equipment, Material Handling Issue, Design of AM.

UNIT-III:
Additive Manufacturing Processes:
Vat Photopolymerization, Materials, Reaction Rates, Photopolymerization Process Modelling, Scan Patterns.

Powder Bed Fusion Processes:

Material Jetting:

Directed Energy Deposition Processes:

Direct Write Technologies:
Ink-Based DW, Laser Transfer DW, Thermal Spray DW, Beam Deposition DW, Liquid Phase Direct Deposition, Hybrid Technologies.

UNIT-IV:
Design & Software Issues:
Additive Manufacturing Design and Strategies; Potentials and Resulting Perspectives, AM based New Strategies, Material Design and Quality Aspects for Additive Manufacturing; Material for AM, Engineering Design Rules for AM.

Software Issue for Additive Manufacturing:
Introduction, Preparation of CAD Models: The STL file, Problem with STL file, STL file Manipulation, Beyond the STL file, Additional Software to Assist AM.

UNIT-V:
Material Design & Quality Aspects:
Applications:
Aerospace, Automotive, Manufacturing, Architectural Engineering, Art, Jewellery, Toys, Medical, Biomedical, Dental, Bio-printing, Tissue & Organ Engineering and many others.

Books and References:
UNIT-I:
Tractor:
Classification of tractors, main tractor assemblies, functions of farm tractors, types of engine used, power requirement, human factor in tractor design, applications of tractors, Basics trends in tractor design, forces acting on a tractor on move, parallel pull and rolling resistance, tractor stability and weight distribution.

UNIT-II:
Hydraulic System:
Functions of hydraulic system, hydraulic components, method of attaching implements, classification of hydraulic controls for hitches, integral hitch system, draft control system. Position control and Mixed control.

UNIT-III:
Tractor Chassis:
Salient features of engine, clutch, power transmission, final drive, brakes and steering of Indian tractors.
Supplementary System:
Power take off shaft, draw bar working, belt pull traction control unit, three-point linkages.

UNIT-IV:
Tractor Wheels and Tyres:
Salient features of wheels, tyres and wheel base/wheel tracks. Specifications of wheels and tyres, dual versus tandem tyres, tread design, effect of tyre inflation. Prominent make of Indian – Tractors. Selection criteria, maintenance and operation of tractors, differential lock.

UNIT-V:
Earth Moving Machinery:
Description and working principles of:
Bull Dozer, Leveller, Front end loader, Cranes, Scraper.
Repair and Maintenance:
Faults and their rectification in tractor and maintenance of tractor.

Books and References:
1. Farm Machines and Equipment by CP Nakra; Dhapat Rai and Sons, New Delhi.
3. Tractors and Agriculture Equipment by Jain and Roy.
COMPUTATIONAL FLUID DYNAMICS

UNIT- I:
Governing Equations and Boundary Conditions:

UNIT -II:
Finite Difference Method:

UNIT- III:
Finite Volume Method (FVM) for Diffusion:

UNIT -IV:
Finite Volume Method for Convection Diffusion:
Steady one-dimensional convection and diffusion. Central, upwind differencing schemes properties of discretization schemes. Conservativeness, Boundedness, Transportive, Hybrid, Power-law, QUICK Schemes.

UNIT- V:
Calculation Flow Field by FVM:
Representation of the pressure gradient term and continuity equation. Staggered grid. Momentum equations. Pressure and Velocity corrections; Pressure Correction equation, SIMPLE algorithm and its variants. Turbulence models, mixing length model, Two equation (k-ε) models. High and low Reynolds number models.

Books and References:
UNIT- I:
Automation:
Definition, Advantages, goals, types, need, laws and principles of Automation. Elements of Automation.
Fluid power and its elements, application of fluid power, Pneumatics vs. Hydraulics, benefit and limitations of pneumatics and hydraulics systems, Role of Robotics in Industrial Automation.

UNIT- II:
Manufacturing Automation:
Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multi model and mixed model production lines. Programmable Manufacturing Automation CNC machine tools, Machining centres, Programmable robots, Robot time estimation in manufacturing operations.

UNIT- III:
Robotics:

UNIT- IV:
Robot Drives and Power Transmission Systems:
Robot end Effectors:
Classification of End effectors – active and passive grippers, Tools as end effectors, Drive system for grippers. Mechanical, vacuum and magnetic grippers. Gripper force analysis and gripper design.

UNIT- V:
Robot Simulation:
Methods of robot programming, Simulation concept, Off-line programming, advantages of offline programming.
Robot Applications:

Books and References:
3. Robotic: Control, Sensing, Vision and Intelligence, by Fu, McGraw Hill.
4. Introduction to Industrial Robotics, by Nagrajan, Pearson India.
5. Robotics, by J.J. Craig, Addison-Wesley.
UNIT-I:
Overview:

UNIT-II:
Emissions in SI engine:

UNIT-III:
Emissions in CI engine:
Basics of Diesel Combustion – Smoke Emission and Its Types in Diesel Engines – NOx Emission and Its Types from Diesel Engines.
Particulate Emission in Diesel Engines. Odour, Sulphur and Aldehyde Emissions from Diesel Engines – Effect of Operating Variables on Emission Formation.

UNIT-IV:
Control techniques for reduction of emission:

UNIT-V:
Test procedure, instrumentation & emission measurement:

Books and References:
UNIT-I:
Overview of Automotive NVH:

UNIT-II:
Transducers and Measurement Techniques:
Transducers and exciters, Sound pressure, intensity and power measurement and Digital signal processing.

NVH Legislations:
Psycho-acoustics and effect of noise on human beings, Ambient air quality standards, Noise specifications for automotive vehicles – pass-by & stationary and Noise specifications for generator sets, fire crackers and household articles.

UNIT-III:
Noise Source Identification Techniques:
Frequency and order domain analysis, Sound intensity and sound power mapping and Introduction to array techniques - Acoustic holography & beam forming.

Modal Analysis:
Definition of Modal Properties, Modal analysis theory, FE & Experimental modal analysis, Excitation sources, Applications of Modal Analysis.

UNIT-IV:
Passive Noise Treatments:
Ducts & Mufflers - Types of mufflers, performance parameters – acoustics and backpressure, Reactive and absorptive silencers and Overall design considerations.

Acoustic Material Characterization - Sound transmission, absorption and damping, Behaviour of acoustic material wrt sound absorption and transmission, Standard methods for evaluating sound absorption coefficient and transmission loss, Types of sound absorbers, Prediction of transmission loss and flanking transmission, Damping materials and their applications.

UNIT-V:
Interior Noise of Automobiles:
Interior noise sources, Structure borne noise, Airborne noise, Refinement techniques, Sound insulation.

Reference Books:
5. Mechanical Vibrations A H Church, John Wiley & Sons Inc.
UNIT-I:
Alcohols as fuels:

UNIT-II:
Vegetable oils as fuels:

UNIT-III:
Hydrogen as engine fuel:

UNIT-IV:
Biogas, natural gas and lpg as fuels:
Production methods of Biogas, Natural gas and LPG. Properties studies. CO2 and H2S scrubbing in Biogas., Modification required to use in SI and CI Engines- Performance and emission characteristics of Biogas, NG and LPG in SI and CI engines.

UNIT-V:
Electric, hybrid and fuel cell vehicles:

Reference Books:
4. Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).
UNIT-I: 
Overview of Material Handling: 
Principles of Material Handling, Principal groups of Material Handling equipment – General Characteristics and application of Material Handling Equipment, Modern trends in material handling.

UNIT-II: 
Lifting Equipment's: Hoist Components of Hoist: 
Load Handling attachments hooks, grabs and clamps – Grabbing attachments for bulk material – Wire ropes and chains.

UNIT-III: 
Lifting tackle pulleys for gain of force and speed: 

UNIT-IV: 
Conveying Machines: 

UNIT-V: 
Current trends in Material Handling: 
Computer Aided Systems for Material Handling.

Reference Books: 
1. Material handling equipments by Rudanko.
2. Conveying machines by A.Spivakvsky and V. Dyachkov.
3. Plant layout and material handling by James Apple.
4. Bulk Materials Handling Handbook by Fruchtbaum J.
5. Bulk Material Handling by Books LLC.
UNIT-I:
Introduction:
Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.

UNIT-II:
Safety concepts:
Active safety: driving safety, conditional safety, perceptibility safety, operating safety, passive safety exterior safety, interior safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact.

UNIT-III:
Safety equipment’s:
Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety.

UNIT-IV:
Collision warning and avoidance:
Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.

UNIT-V:
Comfort and convenience system:
Steering and mirror adjustment, central locking system, Garage door opening system, tyre pressure control system, rain sensor system, environment information system.

Reference Books:
DESIGN OF TRANSMISSION SYSTEMS

UNIT-I:
Flexible transmission elements:
Design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets.

UNIT -II:
Gear transmission:
Speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.

UNIT -III:
Straight bevel gear:
Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears.

UNIT -IV:
Gear box:
Geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.

UNIT -V:
Cam design, types:
Pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.

Books and References:
3. Design of transmission systems by Eamanamurthy and S Machandran.
5. Experimental Stress Analysis for Materials and Structures (Springer Series in Solid and Structural Mechanics)” by Alessandro Freddi and Giorgio Olmi.
UNIT-I:
Automotive air conditioning fundamentals:
Purposes of Heating, Ventilation and Air Conditioning- Environmental Concerns- Ozone layer depletion- Location of air conditioning components in a car. Schematic layout of a vehicle refrigeration system. Psychrometry – Basic terminology and Psychrometric mixtures- Psychrometric Chart- Related problems.

UNIT-II:
Automotive cooling and heating system:

UNIT-III:
Air-conditioning controls, delivery system and refrigerants:
Types of Control devices- Preventing Compressor damage- Preventing damage to other systems- Maintaining driveability- Preventing Overheating Ram air ventilation- Air delivery Components- Control devices- Vacuum Controls Containers. Handling refrigerants – Discharging, Charging & Leak detection – Refrigeration system diagnosis – Diagnostic procedure – Ambient conditions affecting system pressures.

UNIT-IV:
Automatic temperature control:
Different types of sensors and actuators used in automatic temperature control- Fixed and variable displacement temperature control. Semi-Automatic- Controller design for Fixed and variable displacement type air conditioning system.

UNIT-V:
System servicing and testing:
Special tools for servicing vehicle air conditioning – Diagnosing components and air conditioning systems. Diagnosing cooling system- Air delivery system- Automatic temperature Control system diagnosis and service.

Books and References: