

**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

Sl.No.	Subject Code	Subject Name	Department	L-T-P	Th/Lab Marks	Sessional		Total	Credit
					ESE	CT	TA		
1		OPEN ELECTIVE COURSE-1	Other Deptt.	3-0-0	70	20	10	100	3
2		DEPTT ELECTIVE COURSE-3	Core Deptt.	3-0-0	70	20	10	100	3
3		DEPTT ELECTIVE COURSE-4	Core Deptt.	3-1-0	70	20	10	100	4
4	RME701	Computer Aided Design & Manufacturing	Core Deptt.	3-1-0	70	20	10	100	4
5	RAU701	Automotive Transmission	Core Deptt.	3-0-0	70	20	10	100	3
6	RME751	Computer Aided Design & Manufacturing-Lab	Core Deptt.	0-0-2	50		50	100	1
7	RAU751	IC Engine & Pollution Control Lab	Core Deptt.	0-0-2	50		50	100	1
8	RAU753	INDUSTRIAL TRAINING	Core Deptt.	0-0-3			100	100	2
9	RAU754	PROJECT-1	Core Deptt.	0-0-6			200	200	3
	TOTAL				450	100	450	1000	24

DEPARTMENTAL ELECTIVE-3	
S.Code	Subject Name
RAU070	Automotive Electrical & Electronic System
RAU071	Advanced Automobile Technologies
RAU072	Project Management
RME073	Additive Manufacturing

DEPARTMENTAL ELECTIVE-4	
S.Code	Subject Name
RAU075	Automotive Transmission
RAU076	Tractors and Earth Moving Equipment's
RME077	Computational Fluid Dynamics
RME078	Automation & Robotics

- 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

Sl.No.	Subject Code	Subject Name	Department	L-T-P	Th/Lab Marks	Sessional		Total	Credit
					ESE	CT	TA		
2		OPEN ELECTIVE COURSE-2	Other Deptt.	3-0-0	70	20	10	100	3
3		DEPTT ELECTIVE COURSE-5	Core Deptt.	3-1-0	70	20	10	100	4
4		DEPTT ELECTIVE COURSE-6	Core Deptt.	3-0-0	70	20	10	100	3
5	RAU851	SEMINAR	Core Deptt.	0-0-3			100	100	2
6	RAU852	PROJECT-2	Core Deptt.	0-0-12	350		250	600	12
	TOTAL				560	80	380	1000	24

DEPARTMENTAL ELECTIVE-5	
S.Code	Subject Name
RAU080	Automotive Pollution and Control
RAU081	Noise, Vibration and Harness
RAU082	Alternate Energy Sources for Automobiles
RAU083	Material Handling Equipment's

DEPARTMENTAL ELECTIVE-6	
S.Code	Subject Name
RAU085	Vehicle Body Engineering and Safety
RAU086	Trouble Shooting, Service & Maintenance Repair
RME087	Design & Transmission System
RAU087	Automotive Air Conditioning

OR

S.Code	MOOC Subject Name
RME084	Industrial Safety Engineering.

OR

S.Code	MOOC Subject Name
RAU088	Design for Quality, Manufacturing and Assembly.

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:

Classification of Geometric Modelling – Wire frame, Surface and Solid Modelling, applications – representation of curves and surfaces – Parametric form.

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.

Semi-Automatic Methods- Node-based approach, Region based approach, Solid-modelling-based methods.

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 their 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:

Classification and specification – drive and controls – sensors - end effectors - grippers- tool handling and work handling – machine vision – robot programming concepts – case studies in assembly.

Quality Function Deployment:

Process Planning – CAPP – Variant and Generative systems- Concurrent Engineering and Design for Manufacturing.

Advanced manufacturing Planning Computer Aided Production Planning and Control – Aggregate production planning and master production schedule – MRP – MRP II – ERP - Capacity planning.

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:

Systems – characteristics – economics and technological justification – planning, installation, operation and evaluation issues – role of group technology and JIT in FMS – typical case studies future prospects.

Books and References:

1. Chris McMahon and - CAD/CAM – Principle Practice and Manufacturing Management, Jimmie Browne Addison Wesley England , Second Edition,2000.
2. Dr.Sadhu Singh - Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition,2000.
3. P.Radhakrishnan, - CAD/CAM/CIM, New Age International (P) Ltd., New Delhi. S.Subramanayan and V.Raju.
4. Groover M.P. and - CAD/CAM; Computer Aided Design and Manufacturing, Prentice Hall Zimmers EW. International, New Delhi, 1992.
5. Ibrahim Zeid - CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., Company Ltd., New Delhi, 1992.
6. Mikell P.Groover - Automation , Production Systems and Computer Integrated Manufacturing, Second edition, Prentice Hall of India, 2002.
7. S.Kant Vajpayee - Principles of Computer Integrated Manufacturing, Prentice Hall of India, 1999.
8. David Bed worth - Computer Integrated Design and Manufacturing, TMH, 1998.

AUTOMOTIVE TRANSMISSION

L-T-P
3-0-0

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 Synchromesh 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:

Fluid coupling-Principle-Constructional details. Torque capacity. Performance characteristics. Reduction of drag torque in fluid coupling. Torque converter Principle-constructional details, performance characteristics. Multistage torque converters and Polyphase torque converters.

UNIT-III:

Epicyclic gearboxes used in automatic transmission:

Principle of Planetary gear trains – Wilson Gear box, Octal electromagnetic transmission-Hydraulic control system for 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:

Hydrostatic drive; Various types of hydrostatic systems – Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, construction and working of typical Janny hydrostatic drive. Electric drive-types-Principle of early and modified Ward Leonard Control system-Advantages & limitations.

Books and References:

1. Heldt, P.M., “Torque converters”, Chilton Book Co., 1962.
2. Newton and Steeds, “Motor vehicles”, Illiffe Publishers, 1985.
3. Devaradjane. Dr. G., Kumaresan. Dr. M., “Automobile Engineering”, AMK Publishers, 2013.
4. Hydrostatic transmissions for vehicle applications, I Mech E Conference, 1981-88.
5. Crouse, W.H., Anglin, D.L., “Automotive Transmission and Power Trains construction”, McGraw Hill, 1976.
6. Heinz Heisler, “Advance vehicle Technology”, Butterworth-Heinemann, 2002.

COMPUTER AIDED DESIGN & MANUFACTURING LAB

L-T-P

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List of Experiments: (Total EIGHT Experiments are to be 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.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: 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.
5. Pro/E/Idea etc. Experiment: Solid modelling of a machine component.
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.

I.C. ENGINE & POLLUTION CONTROL LAB

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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.
3. Performance Analysis of Four stroke C.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
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.
12. Study & experiment on Fuel Supply System of C.I. Engines- Injector & Fuel Pump.
13. Study & experiment on Air Conditioning System of an Automobile.
14. Study and testing of NO_x emission.
15. Study and testing of SO_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

L-T-P

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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:

1. Young A.P. & Griffiths. L. "Automotive Electrical Equipment", ELBS & New Press- 1999.
2. William B.Riddens "Understanding Automotive Electronics", 5th edition - Butter worth Heinemann Woburn, 1998.
3. Bechhold "Understanding Automotive Electronics", SAE, 1998.
4. Crouse, W.H "Automobile Electrical Equipment", McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.
5. Judge A.W "Modern Electrical Equipment of Automobiles", Chapman & Hall, London, 1992.
6. Kholi.P.L "Automotive Electrical Equipment", Tata McGraw-Hill Co., Ltd., New Delhi, 1975.
7. Robert Bosch "Automotive Hand Book", SAE (5th Edition), 2000.
8. Ganesan.V. "Internal Combustion Engines", Tata McGraw-Hill Publishing Co., New Delhi, 2003.

PROJECT MANAGEMENT

L-T-P
3-0-0

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.
2. Project Management by Choudhury, McGraw Hill.
3. Project Management by K. Nagarajan.
4. Project Management: A Systems Approach to Planning, Scheduling and Controlling, by Kerzner, Wiley.
5. Project Management: A Life Cycle Approach by Kanda, PHI, India.
6. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.
7. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999.
8. Project Management and Appraisal, by Khatua, Oxford University Press.

ADDITIVE MANUFACTURING

L-T-P
3-0-0

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, Powder Fusion Mechanism, Process Parameters and Modelling, powder Handling. Extrusion Based System: Basic principles, plotting and Path Control, Bio extrusion, Other Systems.

Material Jetting:

Materials, Material Processing Fundamentals, Material Jetting Machines. Binder Jetting: Materials, Process Variations, BJ Machines. Sheet lamination Processes: Materials, Ultrasonic Additive Manufacturing.

Directed Energy Deposition Processes:

General DED Process Description, Material Delivery, DED systems, Process Parameters, Processing-Structure-Properties Relationships.

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:

Machines for Additive Manufacturing, Printers, Secondary Rapid Prototyping processes, Intellectual Property, Product Development, Commercialization, Trends and Future Directions in Additive Manufacturing, Business Opportunities

Applications:

Aerospace, Automotive, Manufacturing, Architectural Engineering, Art, Jewellery, Toys, Medical, Biomedical, Dental, Bio-printing, Tissue & Organ Engineering and many others.

Books and References:

1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, by- Ian Gibson, D Savid W. Rosen, Brent Stucker, Springer.
2. Additive Manufacturing, by- Amit Bandyopadhyay, Susmita Bose, CRC Press.
3. Rapid Prototyping: Principles and Applications, by - Chee Kai Chua, Kah Fai Leong, Chu Sing Lim.
4. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing by Ian Gibson and David Rosen.
5. Additive Manufacturing of Metals: From Fundamental Technology to Rocket Nozzles, Medical Implants, and Custom Jewelry (Springer Series in Materials Science) by John O Milewski.
6. Additive Manufacturing: Advanced Manufacturing Technology in 3d Print Deposit by SabrieSoloman.
7. Advances in 3D Printing and Additive Manufacturing Technologies by David Ian Wimpenny and Pulak M Pandey.
8. Understanding Additive Manufacturing, by- Andreas Gebhardt, Hanser.

DEPARTMENTAL ELECTIVE-4

TRACTORS AND EARTH MOVING EQUIPMENTS

L-T-P
3-1-0

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, Scrapper.

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.
2. Manual of Tractors by J Konard, Asia Publishing House.
3. Tractors and Agriculture Equipment by Jain and Roy.
4. Giant Earth Moving Equipment by Eric C Orlemann.
5. Moving The Earth: The Workbook of Excavation Sixth Edition by Herbert L Nichols and David Day.
6. Earth Moving Equipment in Argentina: A Strategic Reference, 2007 by Philip M Parker.
7. Jake's Cranes: The Highway 93 Bypass by Mary Ann Mejdrich.

COMPUTATIONAL FLUID DYNAMICS

L-T-P
3-1-0

UNIT- I:

Governing Equations and Boundary Conditions:

Basics of computational fluid dynamics. Governing equations of fluid dynamics. Continuity, Momentum and Energy equations. Chemical species transport. Physical boundary conditions, Time-averaged equations for Turbulent Flow. Turbulent–Kinetic Energy Equations Mathematical behaviour of PDEs on CFD. Elliptic, Parabolic and Hyperbolic equations.

UNIT -II:

Finite Difference Method:

Derivation of finite difference equations. Simple Methods. General Methods for first and second order accuracy, solution methods for finite difference equations. Elliptic equations. Iterative solution Methods. Parabolic equations. Explicit and Implicit schemes. Example problems on elliptic and parabolic equations.

UNIT- III:

Finite Volume Method (FVM) for Diffusion:

Finite volume formulation for steady state One, Two- and Three-dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank. Nicolson and fully implicit schemes.

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:

1. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, by Versteeg, Pearson, India.
2. Numerical Heat Transfer and Fluid Flow, by Patankar, Tayers & Francis.
3. Computational Heat Transfer, by Jaluriaans Torrance, CRC Press.
4. Computational Fluid Dynamics, by Anderson, Mc Graw Hill.
5. Computational Fluid Dynamics, by Chung, Cambridge University Press.
6. Computer Simulation of flow and heat transfer, by Ghoshdastidar McGraw Hill.
7. Introduction to Computational Fluid Dynamics, by Prodip Niyogi. Pearson India.
8. Computational Fluid Flow and Heat Transfer, by Muralidhar and Sundararajan, Narosa Publishing House.
9. Computational Fluid Dynamics: Principles and Applications, by Blazek, Elsevier Science & Technology.

AUTOMATION & ROBOTICS

L-T-P
3-1-0

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:

Definition, Classification of Robots - Geometric classification and Control classification, Laws of Robotics, Robot Components, Coordinate Systems, Power Source. Robot anatomy, configuration of robots, joint notation schemes, work volume, manipulator kinematics, position representation, forward and reverse transformations, homogeneous transformations in robot kinematics, D-H notations, kinematics equations, introduction to robot arm dynamics.

UNIT -IV:

Robot Drives and Power Transmission Systems:

Robot drive mechanisms: Hydraulic / Electric / Pneumatics, servo & stepper motor drives, Mechanical transmission method: Gear transmission, Belt drives, Rollers, chains, Links, Linear to Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearings.

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:

Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Limitation of usage of robots in processing operation. Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference.

Books and References:

1. An Introduction to Robot Technology, by CoifetChirroza, Kogan Page.
2. Robotics for Engineers, by Y. Koren, McGraw Hill.
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.
6. Industrial Robots, by Groover, McGraw Hill.
7. Robotic Engineering - An Integrated Approach : Richard D. Klafter Thomas A.

8. Robots & Manufacturing Automation, by Asfahl, Wiley.

SEMESTER-VIII

DEPARTMENTAL ELECTIVE-5

AUTOMOTIVE POLLUTION & CONTROL

**L-T-P
3-1-0**

UNIT-I:

Overview:

Pollutants – Sources – Formation – Effects of Pollution on Environment – Human – Transient Operational Effects on Pollution – Regulated – Unregulated Emissions – Emission Standards

UNIT-II:

Emissions in SI engine:

Chemistry of SI Engine Combustion – HC And CO Formation in SI Engines – NO Formation in SI Engines – Smoke Emissions from SI Engines – Effect of Operating Variables on Emission Formation.

UNIT-III:

Emissions in CI engine:

Basics of Diesel Combustion – Smoke Emission and Its Types in Diesel Engines – NO_x 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:

Design Modifications – Optimization of Operating Factors – Fuel Modification – Evaporative Emission Control – Exhaust Gas Recirculation – SCR – Fumigation.

Secondary Air Injection – PCV System – Particulate Trap – CCS – Exhaust Treatment in SI Engines – Thermal Reactors – Catalytic Converters – Catalysts – Use of Unleaded Petrol.

UNIT-V:

Test procedure, instrumentation & emission measurement:

Test Procedures CVS1, CVS3 – Test Cycles – IDC – ECE Test Cycle – FTP Test Cycle – NDIR Analyzer – Flame Ionization Detectors – Chemiluminescent Analyzer – Dilution Tunnel – Gas Chromatograph – Smoke Meters – SHED Test.

Books and References:

1. Springer and Patterson, “Engine Emission”, Plenum Press, 1990.
2. Pundir. B.P., “IC Engines Combustion and Emissions” Narosa Publishers, 2010.
3. Ramalingam. K.K., “Internal Combustion Engines”, Scitech Publications, 2003.
4. Ganesan,V., “Internal Combustion Engines”, Tata McGraw Hill Co., 1994.
5. SAE Transactions, “Vehicle Emission”, 3 Volumes, 1982. 4. Obert,E.F., “Internal Combustion Engines”, 1982.
6. Taylor,C.F., “Internal Combustion Engines”, MIT Press, 1972.
7. Heywood,J.B., “Internal Combustion Engine Fundamentals”, McGraw Hill Book Co., 1995.
8. Automobiles and Pollution SAE Transaction, 1995.

UNIT-I:

Overview of Automotive NVH:

Natural vibration of Single Degree of Freedom System (SDOF) and Multi Degree of Freedom System (MDOF), Undamped, damped and forced vibrations and Vibration of beams, plates & shells. Basics of sound propagation, Quantification of sound, Noise sources, generation and radiation, Pass-by noise limits, Automotive NVH sources, Interior noise of vehicles, Sound quality, Ride comfort, Noise and vibration control in vehicles.

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:

1. Theory of Vibrations with Applications: W T Thomson CBS Publishers Delhi.
2. Mechanical Vibrations: S S Rao Addison-Wesley Publishing Co.
3. Fundamentals of Vibration : Leonard Meirovitch , McGraw Hill International Edison.
4. Principles of Vibration Control :Asok Kumar Mallik, Affiliated East- West Press.
5. Mechanical Vibrations A H Church ,John Wiley & Sons Inc.
6. Mechanical Vibrations J P Den Hartog, McGraw Hill.
7. Mechanical Vibration Analysis: Srinivasan, McGraw Hill.
8. Mechanical Vibrations: G K Groover.
9. Vibration and Noise for Engineers: Kewal Pujara ,Dhanpat Rai And co.

ALTERNATE ENERGY SOURCE FOR AUTOMOBILES

L-T-P
3-1-0

UNIT-I:

Alcohols as fuels:

Introduction to alternative fuels. – Need for alternative fuels – Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives. Performance emission and combustion characteristics in CI and SI engines.

UNIT-II:

Vegetable oils as fuels:

Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Transesterification and emulsification of Vegetable oils – Performance in engines – Performance, Emission and Combustion Characteristics in diesel engines.

UNIT-III:

Hydrogen as engine fuel:

Production methods of hydrogen. Combustive properties of hydrogen. Problems associated with hydrogen as fuel and solutions. Different methods of using hydrogen in SI and CI engines. Performance, emission and combustion analysis in engines. Hydrogen storage – safety aspects of hydrogen.

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:

Layout of Electric vehicle and Hybrid vehicles – Advantages and drawbacks of electric and hybrid vehicles. System components, Electronic control system – Different configurations of Hybrid vehicles. Power split device. High energy and power density batteries – Basics of Fuel cell vehicles.

Reference Books:

1. AyhanDemirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer- Verlag London Limited 2008,ISBN-13: 9781846289941
2. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
3. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.
4. Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).
5. Science direct Journals (Biomass & Bio energy, Fuels, Energy, Energy conversion Management, Hydrogen Energy, etc.) on biofuels.
6. Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.

MATERIAL HANDLING EQUIPMENTS

L-T-P

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:**

Tension in drop parts – Drums, Shears and sprockets – Arresting gear and brakes – Block brakes, Band brakes, thrust brakes – Safety and hand cranks. Principle operation of EOT, Gantry and jib cranes Hoisting Mechanisms, travelling mechanisms, lifting mechanisms – Slewing Mechanisms – Elevators and lifts.

UNIT-IV:**Conveying Machines:**

Belt conveyors – Types, Principal components of a conveyor and their purpose – conveyor belts – tractive elements – take up device's Special types of belt conveyors – Metal Belt conveyor – Apron conveyor Elevators, Passenger conveyor – Flight conveyor, Principal types and application – Bucket flight conveyors – Cradle conveyor – conveyor elevators. Overhead conveyors – Overhead pusher conveyor, Overhead load towing truck conveyor – Load carrying car conveyors – Load towing and walking beam conveyors – Bucket elevators – Cradle conveyors – Screw conveyors – Oscillating conveyor – Roller conveyor Hydraulic and pneumatic conveyor – Chutes Bins.

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.
6. Bulk Material Handling by Conveyor Belt II by Mark Alspaugh.
7. Bulk Material Handling by Conveyor Belt by M AAlspaugh and R O Bailey.
8. Bulk Material Handling by Conveyor Belt 5 by Allen Reicks and Michael T Meyers.

DEPARTMENTAL ELECTIVE-6

VEHICLE BODY ENGINEERING AND SAFETY

L-T-P
3-0-0

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 crumple 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:

1. Bosch, "Automotive Handbook", 8th Edition, SAE publication, 2011.
2. Powloski. J., "Vehicle Body Engineering", Business books limited, London, 1969.
3. Ronald.K.Jurgen, "Automotive Electronics Handbook", Second Edition, McGraw-Hill Inc., 1999.

DESIGN OF TRANSMISSION SYSTEMS

L-T-P

3-0-0

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-speed 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:

1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.
2. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
3. Design of transmission systems by Eamanamurthy and S Machandran.
4. Electrical Power Transmission System Engineering: Analysis and Design” by TuranGonen.
5. Experimental Stress Analysis for Materials and Structures (Springer Series in Solid and Structural Mechanics)” by Alessandro Freddi and Giorgio Olmi.
6. Radio Frequency Transmission Systems: Design and Operation” by Jerry Whitaker.
7. Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001.

AUTOMOTIVE AIR CONDITIONING

L-T-P
3-0-0

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:

Vehicle Refrigeration System and related problems- Fixed thermostatic and Orifice tube system- Variable displacement thermostatic and Orifice tube system- Vehicle air conditioning operation.

Types of compressor- Compressor Clutches- Compressor Clutch electrical circuit- Compressor lubrication- Condensers- Evaporators- Expansion devices- Evaporator temperature and pressure controls- receiver-drier- Accumulators- refrigerant hoses, Connections and other assemblies- 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:

1. Warren Farnell and James D.Halderman, "Automotive Heating, Ventilation, and Air Conditioning systems", Classroom Manual, Pearson Prentice Hall, 2004.
2. Warren Farnell and James D.Halderman, "Automotive Heating, Ventilation, and Air Conditioning systems", Shop Manual, Pearson Prentice Hall, 2004.
3. William H Crouse and Donald L Anglin, "Automotive Air conditioning", McGraw Hill Inc., 1990.
4. Mitchell Information Services, Inc., "Mitchell Automatic Heating and Air Conditioning Systems", Prentice Hall Inc., 1989.
5. Paul Weisler, "Automotive Air Conditioning", Reston Publishing Co. Inc., 1990.

6. McDonald, K.L., "Automotive Air Conditioning", Theodore Audel series, 1978.
7. Goings, L.F., "Automotive Air Conditioning", American Technical services, 1974.