VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY HYDERABAD
B.TECH. II YEAR
(AUTOMOBILE ENGINEERING)

III SEMESTER **R18**

Course Code	Title of the Course	L	T	P	Contact Hours/ Week	Credits
18BS1MT06	Partial Differential Equations and Numerical Methods	3	1	0	4	4
18PC1CS06	Data Structures through C	3	0	0	3	3
18ES1EE02	Basic Electrical and Electronics Engineering	3	0	0	3	3
18PC1ME01	Thermodynamics	3	1	0	4	4
18PC1AE01	Automotive Chassis	3	0	0	3	3
18PC2CS03	Data Structures through C Laboratory	0	0	2	2	1
18ES2EE02	Basic Electrical and Electronics Engineering Laboratory	0	0	2	2	1
18PC2AE01	Automotive Chassis Laboratory	0	0	2	2	1
Total		**15**	**2**	**6**	**23**	**20**

IV SEMESTER **R18**

Course Code	Title of the Course	L	T	P	Contact Hours/ Week	Credits
18PC1ME02	Fluid Mechanics and Machinery	3	1	0	4	4
18PC1AE02	Automotive Engines	3	0	0	3	3
18PC1AE03	Applied Thermodynamics	3	1	0	4	4
18PC1ME05	Mechanics of Solids	3	1	0	4	4
18PC1ME06	Metallurgy and Materials Engineering	3	0	0	3	3
18PC2ME01	Fluid Mechanics and Machinery Laboratory	0	0	2	2	1
18PC2AE02	Automotive Engines Laboratory	0	0	2	2	1
18PC2AE03	Metallurgy and Mechanics of Solids Laboratory	0	0	2	2	1
Total		**15**	**3**	**6**	**24**	**21**
18MN6HS02	Environmental Science	2	0	0	2	0

L – Lecture T – Tutorial P – Practical

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY

B.Tech. III Semester	**L**	**T/P/D**	**C**
	3	**1**	**4**

(18BS1MT06) PARTIAL DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS
(Common to ME and AE)

COURSE PREREQUISITES: Differentiation, Integration

COURSE OBJECTIVES: Student will gain knowledge of
- Evaluation of Fourier coefficients
- Method of Separation of Variables to solve second order Partial Differential Equations
- Numerical methods to solve non-linear systems
- Various methods of interpolation and its application
- Concepts of numerical differentiation and integration

COURSE OUTCOMES: After completion of the course, the student will be able to
CO-1: Determine the Fourier series for periodic functions
CO-2: Solve the second order linear partial differential equations
CO-3: Apply numerical methods to find a root of algebraic and transcendental equations
CO-4: Find the interpolate value from the given set of data points
CO-5: Evaluate problems based on numerical differentiation, integration and numerical solutions of ordinary differential equations

UNIT-I:
Fourier Series: Introduction of Fourier Series, determination of Fourier coefficients, Fourier series in an arbitrary interval, Fourier series for even and odd functions, Half range sine and cosine series

UNIT-II:
Partial Differential Equations of Second Order: Classifications of Second Order Partial differential Equations, Method of separation of variables, Applications: Problems of vibrating string- wave equation, Problems of one-dimensional heat equation, Problems of steady state two dimensional heat flow-Laplace equation.

UNIT-III:
Solutions of Non-linear Systems: Introduction; Mathematical preliminaries; Solution of algebraic and transcendental equations–bisection method, the method of false position, Fixed point iterative method, Newton - Raphson method, and their order of convergence.

UNIT-IV:
Interpolation: Introduction; Errors in polynomial interpolation; Finite differences; Forward differences; Backward differences; Central differences; Symbolic relations and separation of symbols; Differences of a polynomial; Newton's formulae for interpolation; Central difference interpolation formulae; Gauss's central difference formulae and Lagrange's interpolation formulae.

UNIT-V:

Numerical Differentiation and Integration: Numerical differentiation based on interpolation, Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, and Simpson's 3/8 rule, Gaussian quadrature 2 & 3-point formulae.

UNIT-VI:

Numerical Solutions of Ordinary Differential Equations: Solution of initial value problems by Taylor's series - Picard's method of successive approximations, Euler's method, Modified Euler's method and Runge - Kutta methods.

TEXT BOOKS:

1. Higher Engineering Mathematics - B. V. Ramana, McGraw-Hill Publishers
2. Advanced Engineering Mathematics - Erwin Kreyszig, 8th Edition; John Wiley.
3. Introductory Methods of Numerical Analysis - S. S. Sastry, PHI learning Pvt. Ltd.

REFERENCES:

1. Advanced Engineering Mathematics - Peter 'O' Neil, Cengage Learning
2. Advanced Engineering Mathematics - R. K. Jain and S. R. K. Iyengar; Narosa Publication
3. Higher Engineering Mathematics - B. S. Grewal, Khanna Publishers, 36th Edition, 2010.

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B.Tech. III Semester	**L**	**T/P/D**	**C**
	3	**0**	**3**

(18PC1CS06) DATA STRUCTURES THROUGH C
(Common to EEE, EIE, ME and AE)

COURSE OBJECTIVES:
- To summarize efficient storage mechanisms of data for an easy access
- To familiarize concepts of various linear data structures
- To introduce concept of non-linear data structures
- To develop applications using data structures

COURSE OUTCOMES: After completion of the course, the student will be able to
CO-1: Find time complexity notations for various sorting techniques
CO-2: Implement the operations of creation, insertion, deletion on linear data structures
CO-3: Implement the operations of creation, insertion, deletion on non-linear data structures
CO-4: Implement applications using data structure concepts

UNIT-I:
Data Structures – Introduction to data structures, abstract data types. Asymptotic notations. Merge sort, Quick Sort, Radix sort.

UNIT-II:
Linked List: Singly linked list implementation, insertion, deletion and searching operations on linear list, circular linked list implementation
Double linked list implementation, insertion, deletion and searching operations. Applications of Linked Lists – Polynomial addition and subtraction**.**

UNIT–III:
Stacks: Operations, array and linked representations of stacks, stack applications- infix to postfix conversion, postfix expression evaluation, Towers of Hanoi recursive implementation.

UNIT–IV:
Queues: operations, array and linked representations of queues. Circular queue operations, dequeue operations.

UNIT–V:
Trees: Definitions, binary tree representation, binary search tree, binary tree traversals- Preorder, Inorder, Postorder.

UNIT–VI:
Graphs: Definitions, graph representations, spanning tree, graph traversals- BFS and DFS.

TEXT BOOKS:

1. C Programming & Data Structures, B. A. Forouzan and R. F. Gilberg, Third Edition, Cengage Learning.
2. Data Structures Using C (Paperback) by Aaron M. Tenenbaum

REFERENCES:

1. C & Data Structures – P. Padmanabham, Third Edition, B. S. Publications.
2. Data Structures using C – A. M. Tanenbaum, Y. Langsam, and M. J. Augenstein, Pearson Education
3. C Programming & Data Structures, E. Balagurusamy, TMH.
4. C Programming & Data Structures, P. Dey, M. Ghosh R. Thereja, Oxford University Press
5. C & Data Structures – E. V. Prasad and N. B. Venkateswarlu, S. Chand & Co.

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B.Tech. III Semester	**L**	**T/P/D**	**C**
	3	**0**	**3**

(18ES1EE02) BASIC ELECTRICAL AND ELECTRONICS ENGINEERING
(Common to ME and AE)

COURSE PREREQUISITES: Physics, Electrical Engineering & Electronics Engineering

COURSE OBJECTIVES:

- To get awareness of using mechanical energy for electrical energy generation
- To understand the basic operation of circuits used for automobile control
- To know about working of different electrical machines used for propulsion of vehicles
- To know the basic operation of diode and transistor

COURSE OUTCOMES: After completion of the course, the student will be able to

CO-1: Analyze the electro-mechanical energy conversion using electrical machines

CO-2: Analyze the different electrical machines used for propulsion of vehicles

CO-3: Analyze different control circuits which involve different circuits' parameters

CO-4: Analyze the operation of transistor and CRT

UNIT-I:

Electrical Circuits:

Circuit Concept R-L-C Parameters-Ohm's Law - Kirchhoff's Laws - Series - Parallel resistive networks - Star/delta transformations.

AC Circuits: Average value, rms value, form factor of sinusoidal function,R-L, R-C and R-L-C circuits- Concept of Power factor, Real and reactive powers simple problems.

UNIT-II:

DC Machines: Principle of operation of DC Generator – emf equation - types – Principle of operation of DC Motor - DC motor types –torque equation – Three point starter -Swinburne's test, applications.

UNIT-III:

AC Machines I:

Transformers: Principle of operation of single phase transformer–emf equation–losses–OC and SC tests - efficiency and regulation (simple Problems)

UNIT-IV:

AC Machines-II & Instruments: Principle of operation of alternator – regulation by synchronous impedance method –Principle of operation of induction motor – slip – torque characteristics – applications

Instruments: Principle and construction of permanent magnet moving coil and moving iron instruments.

UNIT-V:

Diode and It's Characteristics: P-N junction diode, symbol, V-I Characteristics, Diode Applications: Rectifiers – Half wave Full wave and Bridge rectifiers (simple Problems)

UNIT-VI:

Transistors: PNP and NPN Junction transistor, Transistor as an amplifier, SCR characteristics and applications.

Cathode Ray Oscilloscope:

Principles of CRT (Cathode Ray Tube), Deflection, Sensitivity, Electrostatic and Magnetic deflection, Applications of CRO - Voltage, Current and frequency measurements

TEXT BOOKS:

1. Electronic Devices and Circuits- David A. Bell, Oxford University Press.
2. Introduction to Electrical Engineering - M. S. Naidu and S. Kamakshaiah, TMH Publications.

REFERENCES:

1. Principles of Electrical and Electronics Engineering by V. K. Mehta, S. Chand & Co.
2. Basic Electrical Engineering by Kothari and Nagarath, TMH Publications, 2nd Edition.

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B.Tech. III Semester	**L**	**T/P/D**	**C**
	3	**1**	**4**

(18PC1ME01) THERMODYNAMICS
(Common to ME and AE)

COURSE PREREQUISITES: Physics, Mathematics

COURSE OBJECTIVES:
- To apply the basic concepts of thermodynamics, heat and work done on the system
- To apply the basic concepts of Thermodynamic Laws for various thermodynamic systems
- To evaluate the properties of pure substance and to analyse the concept of irreversibility and availability
- To apply the basic concept of power cycles for External combustion engines and internal combustion engines
- To evaluate the behaviour of ideal gas mixtures and thermodynamic properties

COURSE OUTCOMES: After completion of the course, the student will be able to
CO-1: To apply the basic concepts of thermodynamics, heat and work done on the system.
CO-2: To apply the basic concepts of thermodynamic laws for various thermodynamic systems
CO-3: To evaluate the properties of pure substance and to analyse the concept of irreversibility and availability
CO-4: To apply the basic concept of power cycles for external combustion engines and internal combustion engines
CO-5: To evaluate the behaviour of ideal gas mixtures and thermodynamic properties

UNIT-I:
Concepts and Definitions: Thermodynamic system and control volume; Macroscopic versus microscopic point of view; Properties and state of a substance; Processes and cycles, Energy, Specific volume and density, Equality of temperature; The Zeroth law of thermodynamics; Temperature scales.
Work and Heat: Definition of work; Units for work; Work done at the moving boundary of a simple compressible system; Other systems that involve work; Definition of heat; Heat transfer modes; Comparison of heat and work.

UNIT-II:
The First Law of Thermodynamics: The first law of thermodynamics for a control mass undergoing a cycle; The first law of thermodynamics for a change in state of a control mass; Internal energy-a thermodynamic property; Problem analysis and solution technique; Enthalpy; The constant-volume and constant-pressure specific heats; The internal energy, enthalpy, and specific heat of ideal gases; The first law as a rate equation.
First Law Analysis for a Control Volume: Conversion of mass and the control volume, the first law of thermodynamics for a control volume, The steady-state process; Examples of steady-state processes.

UNIT-III:

The Second Law of Thermodynamics: Heat engines and refrigerators; The second law of thermodynamics; The reversible process; Factors that render processes irreversible; The Carnot cycle; Two propositions regarding the efficiency of a Carnot cycle; The thermodynamic temperature scale; The ideal-gas temperature scale; Ideal versus real machines.

Entropy for a Control Mass: The inequality of Clausius; Entropy — a property of a system; The entropy of a pure substance; Entropy change in reversible processes; The thermodynamic property relation; Entropy change of an ideal gas; The reversible polytropic process for an ideal gas; Entropy change of a control mass during an irreversible process; Entropy generation; Principle of increase of entropy; Entropy as a rate equation.

UNIT-IV:

Irreversibility and Availability: Available energy; Available energy Referred to a cycle; Quality of energy; Maximum work in a reversible process; reversible work by an open system; Exchanging heat only with the surroundings; Useful work; Dead state; Availability; Availability in chemical reaction; Irreversibility and Gouy-stodola Theorem; Availability or Exergy Balance; second law efficiency;

Properties of a Pure Substance: The pure substance; Vapor- liquid- solid- phase equilibrium in a pure substance; Independent properties of a pure substance; Steam Tables; Thermodynamic surfaces; The compressibility factor; Equations of state.

UNIT-V:

Power Cycles: Introduction to power systems; The Rankine cycle; Effect of pressure and temperature on the Rankine cycle; Air-standard power cycles; Basic Brayton cycle; The air-standard cycle for jet propulsion; Reciprocating engine power cycles; The Otto cycle; The Diesel cycle; The Dual cycle, The Stirling cycle; The Atkinson and Miller cycles.

UNIT-VI:

Properties of Gases and Gas Mixtures: Avogadro's Law; Ideal Gas; Equation of State; Law of Corresponding; Properties of Mixture of Gases-Dalton's Law of Partial Pressures; Internal Energy, Enthalpy, and Specific Heats of Gas Mixtures; Entropy of Gas Mixtures; Gibbs Function of a Mixture of Inert ideal Gas;

Thermodynamic Property Relations: Mathematical relations for a homogeneous phase; The Maxwell relations; Thermodynamic relations involving enthalpy, internal energy, and entropy; The Clapeyron equation; Joule-Thompson coefficient.

TEXT BOOKS:

1. Engineering Thermodynamics by P. K. Nag, McGraw-Hill
2. Fundamentals of Thermodynamics by C. Borgnakke, R. E. Sonntag, and G. J. Van Wylen; John Wiley.

REFERENCES:

1. Engineering Thermodynamics by Burgadt, Harper & Row Publication.
2. Thermodynamics — An Engineering Approach by Yunus Cengel and Boles; TMH.
3. Engineering Thermodynamics by P. Chattopadhyay, Oxford University Press

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B.Tech. III Semester	**L**	**T/P/D**	**C**
	3	**0**	**3**

(18PC1AE01) AUTOMOTIVE CHASSIS

COURSE PREREQUISITES: Applied Physics

COURSE OBJECTIVES:
- To illustrate the vehicle lay-out and body types
- To provide the working of transmission systems
- To learn the basic functionality of final drive, steering and brake systems
- To present the construction and working of suspension and wheel and tyre assembly

COURSE OUTCOMES: After completion of the course, the student will be able to
CO-1: Understand the vehicle lay-out and body types
CO-2: Comprehend the working of drive line systems
CO-3: Appreciate the basic functionality of final drive, steering and brake systems
CO-4: Describe the construction and working of suspension and wheel and tyre assembly

UNIT-I:
Frame and Body: Classification of automobiles, layout of chassis and sub systems and their role, types of chassis - light, medium and heavy duty vehicle chassis. Role and requirement of a chassis frame, types of frames, materials, loading points and types of bodies.

UNIT-II:
Clutch and Gear Box: Types of clutch - single plate clutch, coil spring type and diaphragm spring type, multiple plate clutch, centrifugal clutch. Need for gearbox, types of gear box - sliding mesh, constant mesh and synchromesh, overdrives, transfer case and gear shifting mechanisms.

UNIT-III:
Automatic Transmission: Need for fluid coupling and torque converters, epicyclical gearbox, automatic transmission – automatic manual transmission, continuously variable transmission and fully automatic transmission, control mechanisms and limitations.

UNIT-IV:
Drive Line and Final Drive: Propeller shaft drive, torque reaction and drive thrust, Hotchkiss drive, torque tube drive and universal joints. Front axle and its types, stub axle and its types, rear axle and its types. Need for differential, working, non-slip differentials and differential lock.

UNIT-V:
Steering System: Principle of steering, Ackerman's and Davis steering mechanisms, steering layout, types of steering gearbox, types of front axle and stub axle, steering geometry. Purpose, working and types of power steering.

Brake System: Stopping distance, time and braking efficiency, effect of weight transfer, braking torque, classification of brakes, drum and disc brakes, construction and working of mechanical, hydraulic, pneumatic, power-assisted brakes and servo brakes.

UNIT-VI:

Suspension System: Types of suspension - rigid axle suspension and independent suspension, types of suspension spring - leaf spring, coil spring, torsion bar spring, air spring, rubber spring and hydro elastic spring. Role and types of shock absorber, construction and working.

Tyres and Wheels: Types and construction of wheel, tyre requirements, bias ply and radial ply tyres, tubeless tyres, wheel balancing and tyre rotation.

TEXTBOOKS:

1. Heinz Heisler, Advanced Vehicle Technology, 2nd Edition, Butterworth Heinemann Publishers, 2002.
2. Giri N. K., Automotive Mechanics, Khanna Publications, 2008.

REFERENCES:

1. Garrett T. K., Newton K. and Steeds W., The Motor Vehicle, 13th Edition, Butterworth Heinemann Publishers, 2001.
2. William Crouse and Donald Anglin, Automotive Mechanics, 10th Edition, McGraw-Hill Publication, 2010.
3. Srinivasan S., Automotive Mechanics, 2nd Edition, McGraw-Hill Publishing Company Ltd., 2003.
4. Heldt P. M., Automotive Chassis, Chilton & Co., 1996.

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B.Tech. III Semester	**L**	**T/P/D**	**C**
	0	**2**	**1**

(18PC2CS03) DATA STRUCTURES THROUGH C LABORATORY
(Common to EEE, EIE, ME and AE)

COURSE OBJECTIVES:
- To **impart** the implementation of data structures such as linked lists, Stacks and Queue
- To **introduce** the various advanced data structures such as tree traversals
- To **analyze** the sorting algorithms
- To **teach** the various graph traversal algorithms

COURSE OUTCOMES: After completion of the course, the student will be able to
CO-1: Analyze the algorithms to determine the time and space complexities
CO-2: Implement the linear data structures like stacks, queues and linked lists
CO-3: Evaluate the non-linear data structures like Trees and graphs
CO-4: Predict the tree and graph traversing techniques

WEEK 1
1. Write a C program for Merge Sort

WEEK 2
2. Write a C Program for Quick Sort
3. Write a C program for Radix Sort

WEEK 3
4. Write a C program for SLL creation, insertion, deletion, searching, display operations.

WEEK 4
5. Write a C program for CLL creation, insertion, deletion, searching, display operations.

WEEK 5
6. Write a C program for DLL creation, insertion, deletion, searching, display operations.

WEEK 6
7. Write a C program to implement STACK operations using arrays and Linked List.

WEEK 7
8. Write a C Program for infix to postfix conversion.

WEEK 8
9. Write a C program for postfix evaluation.

10. Write a C program for tower of Hanoi problem

WEEK 9

11. Write a C program to implement QUEUE operations using arrays and LL.

WEEK 10

12. Write a C program to implement CIRCULAR QUEUE operations using arrays.

WEEK 11

13. Write a C program to implement DEQUEUE operations using arrays.

WEEK 12

14. Write a C program to implement Binary tree traversals using recursion.

WEEK 13

15. Write a C program to implement Graph traversals (BFS and DFS).

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B.Tech. III Semester	**L**	**T/P/D**	**C**
	0	**2**	**1**

(18ES2EE02) BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY
(Common to ME and AE)

COURSE OBJECTIVES:
- To understand the performance of DC Shunt Machine
- To understand the performance of AC machines
- To understand the performance and efficiency / regulation of electrical machines are determined experimentally
- To understand the operation of solid state devices like diode, transistor and SCR

COURSE OUTCOMES: After completion of the course, the student will be able to
CO-1: Find the application of electrical machines with the experimental determination of the performance of the machines
CO-2: Find the application of Induction motor with the experimental determination of the performance of the machines
CO-3: Find the application of single phase transformer
CO-4: Identify the characteristics of all solid state devices

Section A: Electrical Engineering:
The following experiments are required to be conducted as compulsory experiments:
1. Swinburne's test on D.C. Shunt machine. (Predetermination of efficiency of a given D.C. Shunt machine working as motor and generator)
2. Brake test on D.C Shunt Motor
3. OC and SC tests on single phase transformer(Predetermination of efficiency and regulation at given power factors)
4. Brake test on 3-phase Induction motor (Determination of performance characteristics)
5. Regulation of alternator by Synchronous impedance method

Section B: Electronics Engineering:
The following experiments are required to be conducted as compulsory experiments:
1. P-n Diode Characteristics
2. Transistor CE Characteristics (Input and Output)
3. Full wave Rectifier with and without filters
4. CE Amplifiers
5. SCR Characteristics

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B.Tech. III Semester	**L**	**T/P/D**	**C**
	0	**2**	**1**

(18PC2AE01) AUTOMOTIVE CHASSIS LABORATORY

COURSE PREREQUISITES: Automotive Chassis

COURSE OBJECTIVES:
- To identify and study of automotive chassis systems
- To distinguish functionality of various running and control systems
- To understand the troubles and remedies chassis systems

COURSE OUTCOMES: After completion of the course, the student will be able to
CO-1: Demonstrate the principle and functionality of various automotive systems
CO-2: Dismantle and assemble chassis systems
CO-3: Inspect and identify the faults chassis systems

LIST OF EXPERIMENTS:

Any ten experiments
1. Dismantling, inspection and assembling of clutch
2. Dismantling, inspection and assembling of sliding mesh gear box
3. Dismantling, inspection and assembling of constant mesh gear box
4. Dismantling, inspection and assembling of synchromesh gear box
5. Dismantling, inspection and assembling of automatic gear box
6. Dismantling, inspection and assembling of transaxle and transfer case
7. Dismantling, inspection and assembling of differential unit
8. Dismantling, inspection and assembling of brake system
9. Dismantling, inspection and assembling of suspension system
10. Dismantling, inspection and assembling of steering gear box
11. Dismantling, inspection and assembling of front and rear axle
12. Study of automotive chassis and body

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B.Tech. IV Semester	**L**	**T/P/D**	**C**
	3	**1**	**4**

(18PC1ME02) FLUID MECHANICS AND MACHINERY
(Common to ME and AE)

COURSE OBJECTIVES:
- Understanding the properties of fluids, principles of buoyancy, flow, force and head calculations
- Evaluation of types of fluid flow, Laminar and dynamic
- Knowledge on boundary layer principles applied to airfoils
- Principles of operation of different types of hydraulic machinery
- Understanding Hydraulic systems

COURSE OUTCOMES: After completion of the course, the student will be able to
CO-1: Analyzing the fluid properties to solve flow, force and velocity problems
CO-2: Evaluating the flow characterizing in static and dynamic nature of flow
CO-3: Applying fluid flow and dynamics in solving problems in hydraulic machines
CO-4: Understanding the model analysis of hydraulic machinery and select appropriate machines for hydro power plant
CO-5: Analyzing the hydraulic systems

UNIT-I:
Fluid Statics: Properties of fluid – specific gravity, viscosity, surface tension, vapor pressure and their influence on fluid motion, Pressure at a point, measurement of pressure, Forces on immersed surfaces, Center of pressure, Buoyancy, Elements of stability of floating and submerged bodies.

UNIT-II:
Fluid Kinematics: Introduction, methods of describing the fluid motion, Classification of flows, acceleration equations, Stream line, path line and streak lines and stream tube, continuity equation, Stream function, velocity potential function, introduction to free and forced vortex flows.

UNIT-III:
Fluid Dynamics: Surface and body forces – Euler's and Bernoulli's equation, Venturimeter, Orifice meter, Pitot tube, Reynolds experiment –Darcy Weisbach equation – Minor losses in pipes – pipes in series and pipes in parallel. Momentum equation, force on pipe bends.

UNIT-IV:
Boundary Layer Theory: Development of boundary layer along a thin flat plate, laminar boundary layer and turbulent boundary layer, Laminar sub layer, boundary layer separation, Drag and lift forces - Aero foils, pressure and form drags.
Impact of Jets: Hydrodynamic force of jets on flat, inclined and curved vanes - jet striking centrally and at tip, flow over radial vanes.

UNIT-V:
Hydraulic Turbines: Classification of turbines, design of Pelton wheel, Francis turbine and Kaplan turbine – working proportion, work done, efficiency, draft tube- theory,

functions and efficiency. Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank and water hammer, elements of hydropower plant.

UNIT-VI:

Hydraulic Pumps: Classification, centrifugal pumps – types, working, work done, monomeric head, losses and efficiency, specific speed – pumps in series and parallel – performance characteristic curves, NPSH, Reciprocating Pump – types, Working, Discharge, slip, indicator diagrams

TEXT BOOKS:

1. Hydraulics and Fluid Mechanics Including Hydraulics Machines: P. N. Modi, S. M. Seth
2. Introduction to Fluid Mechanics: R. W. Fox, A. T. McDonald and P. J. Pritchard.

REFERENCES:

1. Fluid Mechanics: V. L. Streeter & E. B. Wylie.
2. Fluid Mechanics, Fundamentals & Applications: Yunus A. Çengel, John M. Cimbala
3. Fluid Mechanics: F. M. White
4. Fundamentals of Fluid Mechanics: Bruce Roy Munson, Donald F. Young, Theodore H. Okiishi, Wade W. Huebsch, Wiley Publication.

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B.Tech. IV Semester	**L**	**T/P/D**	**C**
	3	**0**	**3**

(18PC1AE02) AUTOMOTIVE ENGINES

COURSE PREREQUISITES: Physics and Chemistry

COURSE OBJECTIVES:
- To present the constructional details and combustion in automotive engines
- To learn the principle and functions of an automotive engine sub-systems
- To know engine measurements and performance characteristics
- To provide the concepts and working of unconventional engines

COURSE OUTCOMES: After completion of the course, the student will be able to
CO-1: Understand the constructional details and combustion in automotive engines
CO-2: Describe the principle and functions of an automotive engine sub-systems
CO-3: Analyze engine measurements and performance characteristics
CO-4: Discuss the concepts and working of unconventional engines

UNIT-I:
Engine: Classification, principle, construction and working of four stoke and two stroke SI and CI engines. Theoretical and actual indicator, valve and port timing diagrams, stages of combustion in SI and CI engines, abnormal combustion and combustion chambers.

UNIT-II:
Fuel System: Air fuel ratio requirements, principle and working of carburetor, multi-point fuel injection and gasoline direct injection. Diesel fuel injection pump, types of nozzles and common rail direct injection.

UNIT-III:
Engine Sensors and Actuators: Role of engine management system, sensors – engine speed, mass air flow, manifold absolute pressure, throttle position, knock, temperature, exhaust oxygen level and accelerometers, actuators - solenoids, relays, piezoelectric force generators and stepper motors and engine mapping.

UNIT-IV:
Cooling and Lubrication: Necessity of cooling, air-cooling, water cooling - thermosyphon and pump cooling, radiator, pump, thermostat, antifreeze solution and radiator fan. Mist, splash and forced lubrication, oil filters and oil pumps.

UNIT-V:
Engine Performance and Supercharging: Engine power, measurement of friction power, engine efficiencies, performance characteristics and heat balance. Supercharging - mechanical supercharging, turbocharging, types of superchargers and methods of supercharging.

UNIT-VI:
Unconventional Engines: Stiriling engine - Working Principle, two piston engine, control system, fuel requirement, emissions, merits and demerits. Wankel engine -

Construction and working, performance, emissions, merits and demerits. Variable compression ratio engine - Necessity, theoretical analysis, different methods. Free piston engine - Different types, construction and working, performance, merits and demerits.

TEXT BOOKS:

1. John B. Heywood, "Internal Combustion Engine Fundamentals", 2nd Edition, McGraw-Hill Education, 2018.
2. Mathur M. L. and Sharma R. P., "Internal Combustion Engines", Dhanpat Rai Publications, New Delhi, 2014.

REFERENCES:

1. Ganesan V., "Internal Combustion Engines", 4th edition, Tata McGraw-Hill, New Delhi, 2017.
2. Heinz Heisler, Advanced Vehicle Technology, Butterworth Heinemann Publishers, 2002.
3. Richard Stone, "Introduction to Internal Combustion Engines, SAE Publications, 1999.
4. Willard W. Pulkrabek, Internal Combustion Engine, Prentice Hall Publication, 1997.

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B.Tech. IV Semester	**L**	**T/P/D**	**C**
	3	**1**	**4**

(18PC1AE03) APPLIED THERMODYNAMICS

COURSE PREREQUISITES: Mathematics and Thermodynamics

COURSE OBJECTIVES:
- To extend thermodynamic principles to different thermodynamic systems
- To understand the energy conversion processes and equipment
- To provide basic concepts of refrigeration and psychrometry

COURSE OUTCOMES: After completion of the course, the student will be able to
CO-1: Apply thermodynamic principles to understand various thermodynamic systems
CO-2: Investigate the effectiveness of energy conversion processes/components in mechanical power generation
CO-3: Analyse the vapour compression refrigeration cycle and carry out basic psychrometric calculations

UNIT-I:
Steam Generators: Introduction, classification of boilers, working principles of fire tube and water tube boilers, low pressure boilers, high pressure boilers, Babcock and Wilcox, Lamont boiler, boiler draught, performance of boilers and equivalent evaporation.

UNIT-II:
Steam Condensers: Introduction, purpose and types of condenser, efficiency of condenser and Edward air pump.
Steam Nozzles: Functions of nozzle, applications, types, flow through nozzles, thermodynamic analysis, assumptions, velocity of nozzle at exit, ideal and actual expansion in nozzle, velocity co-efficient, condition for maximum discharge and critical pressure ratio.

UNIT-III:
Impulse Turbine: Mechanical details, velocity diagram, effect of friction, power developed, axial thrust, diagram efficiency, condition for maximum efficiency and methods to reduce rotor speed.
Reaction Turbine: Mechanical details, principle of operation, Thermodynamic analysis of a stage, Degree of reaction, velocity diagram, parson's reaction turbine and condition for maximum efficiency.

UNIT-IV:
Reciprocating Compressors: Principle of operation, work required, isothermal efficiency, volumetric efficiency and effect of clearance, multi stage compression, under cooling, saving of work and minimum work condition for stage compression.
Rotary Compressors: Classification, roots blower, vane blower, centrifugal compressor and axial compressor (Qualitative treatment only).

UNIT-V:

Gas Turbines: Classification of gas turbine plants, ideal cycle, essential components, parameters of performance, actual cycle, regeneration, inter cooling and reheating.

Jet and Rocket Propulsions: Classification of Jet propulsion, turbo jet and turboprop. Solid and liquid propellant rockets.

UNIT-VI:

Refrigeration: Ideal refrigeration cycles - Vapor compression refrigeration cycle, Bell Coleman refrigeration cycle and vapour absorption refrigeration system

Psychrometry: Psychrometric properties, psychrometric chart and psychrometric processes – Sensible heating and cooling, humidification and dehumidification, humidification with heating/cooling and dehumidification with heating/cooling.

TEXT BOOKS:

1. Mahesh M. Rathore, Thermal Engineering, McGraw-Hill Education (India) Pvt. Ltd., 2016.
2. Ganesan V., Gas Turbines, TMH Publications, 2010.

REFERENCES:

1. Rajput R. K., Thermal Engineering, Laxmi Publications, 2010.
2. Yadav R., Thermodynamics and Heat Engines, Central Book Depot, 2002.
3. Ballaney P. L., Thermal Engineering, Khanna Publishers, 2010.
4. Khajuria P. and Dubey S. P., Gas Turbines and Propulsive systems, Dhanpat Rai & Sons, 2012.

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B.Tech. IV Semester	**L**	**T/P/D**	**C**
	3	**1**	**4**

(18PC1ME05) MECHANICS OF SOLIDS
(Common to ME and AE)

COURSE PREREQUISITES: Mathematics, Physics and Engineering Mechanics

COURSE OBJECTIVES:
- List and define the Material properties and show the relationships between them.
- Describe principles of Mechanics, Stress and Strain.
- Demonstrate throughly the concepts of principal stresses applied to solid structural members and mohr's circle diagram.
- Analyse various types of mechanical engineering problems concern to bending of beams, torsion of shafts etc.

COURSE OUTCOMES: After completion of the course, the student will be able to
CO-1: Show basic stress strain equations with appropriate assumptions
CO-2: Interpret model and analyze solid mechanics problems on bars, beams and shafts
CO-3: Apply the concepts of principal stresses in real life design issues
CO-4: Analyse and develop beams, shafts for various applications

UNIT-I:
Tension, Compression, and Shear: Introduction; Normal Stress and Strain; Stress-strain diagrams; Elasticity and plasticity; Linear elasticity and Hooke's law; Allowable stress and allowable loads.
Axially Loaded Members: Introduction; Deflections of axially loaded members; Strain energy; Dynamic loading.
Thermal Stresses

UNIT-II:
Shear Force and Bending Moment Diagrams: Types of beams; Types of loading; Shear force and bending moment; Relationship between load, shear force and bending moment; Shear force and bending moment diagrams.

UNIT-III:
Area Moment of Inertia of Composite Sections:
Stresses in Beams: Introduction; Normal strains in beams; Normal stresses in beams; Cross-sectional shapes of beams-C, angular and semicircle structures; Shear stresses in rectangular beams; Shear stress in webs of beams with flanges; Shear stress in circular beams (solid and hollow sections); Concept of shear center and shear flow.

UNIT-IV:
Analysis of Stress and Strain: Introduction; Plane stress; Principal stresses and maximum shear stresses; Mohr's circle for plane stress; Hooke's law for plane stress; Spherical and cylindrical pressure vessels (biaxial stress; Hoop and longitudinal stresses); Combined loadings (plane stress); Principal stresses in beams.

UNIT-V:

Deflections of Beams: Introduction; Differential equations of the deflection curve; Deflections by integration of the bending moment equation; Deflections by integration of the shear-force and load equations; Macaulay's method; Moment area method; Method of superposition.

UNIT-VI:

Columns: Short columns, Euler's theory for axially loaded elastic long columns, Effective length, Limitations of Euler's Theory, Rankine's formula

Torsion: Introduction; Torsion of circular bars; Non uniform torsion; Pure shear; Relationship between modulus of elasticity E and G; Transmission of power by circular shafts.

TEXT BOOKS:

1. Mechanics of Materials (SI units) by J. M. Gere and S. P. Timoshenko; CBS Publishers.
2. Strength of Materials by S. S. Rattan, Tata McGraw-Hill Education.

REFERENCES:

1. Engineering Mechanics of Solids by Popov; Pearson Education.
2. Strength of Materials by Schaum's Series.

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B.Tech. IV Semester	**L**	**T/P/D**	**C**
	3	**0**	**3**

(18PC1ME06) METALLURGY AND MATERIALS ENGINEERING
(Common to ME and AE)

COURSE PREREQUISITES: Physics and Chemistry

COURSE OBJECTIVES:
- Understand the microstructures of different types of metal and alloys –cast iron, steels, non-ferrous metal and alloys
- Understand the heat treatment principles-annealing, normalizing and hardening
- Understand the different types of tools
- Able to understand the importance of titanium & its alloys

COURSE OUTCOMES: After completion of the course, the student will be able to
CO-1: Distinguish different types of metals, solid solutions, alloys compounds and phases
CO-2: Design a heat treatment process to change the properties-hardness, ductility, etc.
CO-3: Analyze the characters and failure of metals and alloys
CO-4: Explain & justify the usage of composites in engineering field

UNIT-I:
Metal Structure and Crystallization: Introduction - atom binding, ionic bond, covalent bond, metallic bond, and Vander Waals forces; Crystal imperfections.
Overview of Metal Structure and Crystallization. **Constitution of Alloys:** Introduction; Classification of alloys or compounds; Pure metal; Intermediate alloy phase or compound - intermetallic compounds or valency compounds, interstitial compounds, and electron compounds; Solid solutions; Substitution solid solution - factors that control the range of solubility in alloy system; Interstitial solid solutions.

UNIT-II:
Phase Diagrams: Introduction; Coordinates of phase diagrams; Experimental methods - construction of equilibrium diagrams by thermal analysis, metallographic methods, and X-ray diffraction; Type-I-Two metals completely soluble in the liquid and solid states; Chemical composition of phases; relative amounts of each phase; Equilibrium cooling of a solid solution alloy; Diffusion; Nonequilibrium cooling; Homogenization; Properties of solid-solution alloys; Variation of Type I; Type II-Two metals completely soluble in the liquid state and completely insoluble in the solid state; Type III-Two metals completely soluble in the liquid state but only partly soluble in the solid state; Properties of eutectic alloy systems; Age hardening – solution treatment, and aging process; Type IV-The congruent-melting intermediate phase; Type V-The peritectic reaction; Type VI-Two liquids partly soluble in the liquid state: the monotectic reaction; Type VII-two metals insoluble in the liquid and solid states; Interrelation of basic types;

UNIT-III:

The Heat Treatment of Steel: Introduction; Full Annealing; Spheroidizing; Stress-relief annealing; Process annealing; Normalizing; Hardening; The isothermal transformation diagram; Cooling curves and I-T Diagram; Transformation on continuous cooling; Position of the I-T curves,Hardening or austenitizing temperature, Mechanism of heat removal during quenching - vapor-blanket cooling state (stage A), vapor transport cooling stage (stage B), Liquid cooling stage (stage C); Quenching medium; Temperature of quenching medium, Surface condition - methods to minimize the formation of scale - copper plating, protective atmosphere, liquid-salt pots, and cast-iron chips; Size and Mass,Hardenability; Use of Hardenability data; Tempering; Austempering; Surface heat treatment or case hardening; Carburizing; Heat treatment after carburizing; Cyaniding and Carbonitriding; Nitriding; Flame hardening; Induction Hardening.

UNIT-IV:

Alloy Steels: Introduction; Purpose of alloying; Effect of alloying elements upon Ferrite; Effect of alloying elements upon carbide; Influence of alloying elements on the iron-iron carbide diagram; Effect of alloying elements in tampering; Classification of steels - nickel steel, chromium steel, nickel-chromium steels, manganese steels, molybdenum steels, tungsten steels, vanadium steels, silicon steels, stainless steels, martensitic stainless steels, ferritic stainless steels, austenitic stainless steels, precipitation-hardening stainless steels, maraging steels, and ausforming.

TOOL STEELS: Classification of tool steels; Selection of tool steels; Comparative properties; Non-deforming properties; Depth of hardening; Toughness; Wear resistance; Red-hardness; Machinability; Resistance to decarburization; Brand names; Water-hardening tool steels (Group W); Shock resisting tool steels (Group S); Cold-work tool steels; Hot-work tool steels (Group H); High speed tool steels; Mold Steels (Group P); Special purpose tool steels; Heat treatment of tool steels; Overview of tool failures;

Special cutting materials – satellites, cemented carbides, and ceramic tools.

UNIT-V:

Cast Iron: Introduction; Types of cast iron; White cast iron; Malleable cast iron; Pearlitic malleable iron; Gray cast iron; Silicon in cast iron; Sulfur in cast iron; Manganese in cast iron; Phosphorus in cast iron; Heat treatment of grey iron, Size and distribution of graphite flakes; Mechanical properties and applications of grey cast iron; Chilled cast iron; Nodular cast iron; Alloy cast irons.

Non-Ferrous Metals and Alloys: Introduction; Copper and its alloys - Copper, temper designation of copper and copper alloys, and copper alloys; Aluminum and its alloys - Aluminum, Alloy designation system, and temper designation; Titanium and Titanium alloys.

UNIT-VI:

Composites: Introduction, classification of composites-Fibre reinforced composites, Pertial reinforced composites, Dispersion strengthened metals ,laminates; Advanced Fibre reinforced composites –Metal matrix composites, Ceramic –matrix composites ,Carbon - Carbon composites, Hybrid composites; Fabrication of Fibre- reinforced composites-Hand lay –up process ,Filament winding process, Sheet- moulding compound process, continuous pultrusion process, resin transfer moulding, vacuum-bag moulding.

TEXT BOOKS:

1. Introduction to Physical Metallurgy by Sidney H. Avner; McGraw-Hill.
2. Materials Science and Metallurgy by Kodgire, Everest.

REFERENCES:

1. Essentials of Materials Science and Engineering by Donald R. Askeland and Thomson.
2. Materials Science and Engineering by William and Collister.
3. Elements of Materials Science by V. Raghavan.
4. Metallurgy and Material Science by Pakirappa

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B.Tech. IV Semester	**L**	**T/P/D**	**C**
	0	**2**	**1**

(18PC2ME01) FLUID MECHANICS AND MACHINERY LABORATORY
(Common to ME and AE)

COURSE PREREQUISITES: Fluid Mechanics and Hydraulic Machines

COURSE OBJECTIVES:
- Analyzing the experiments to understand the concept, find the values and obtain the result of experiments
- Apply fundamental principles of fluid mechanics for the solution of practical mechanical engineering problems of water conveyance in pipes, orifices, mouth pieces, notches & weirs
- Analyzing various pumps, water turbines, pipes and pressure measurement devices
- Evaluating efficiency for pumps and turbines

COURSE OUTCOMES: After completion of the course, the student will be able to
CO-1: Apply fundamental equations of fluid mechanics for turbines and pumps
CO-2: Model and analyse fluid flow problems in mechanical engineering
CO-3: Create a model of fluid flow equipments
CO-4: Evaluate the experimental results with theoretical concepts

LIST OF EXPERIMENTS:

ANY 10 EXPERIMENTS to be conducted from the following**:**
1. Verification of Bernoulli's theorem
2. Calibration of Venturimeter / Orifice meter.
3. Calibration of notches.
4. Determination of friction factor for a given pipe.
5. Determination of Minor losses for the given equipment
6. Impact of jet on vanes.
7. Performance test on Pelton wheel.
8. Performance test on Francis turbine.
9. Performance test on Kaplan turbine.
10. Performance test on single stage centrifugal pump.
11. Performance test on multi stage centrifugal pump.
12. Performance test on reciprocating pump.

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	0	**2**	**1**

(18PC2AE02) AUTOMOTIVE ENGINES LABORATORY

COURSE PREREQUISITES: Thermodynamics, Automotive engines

COURSE OBJECTIVES:

- To show valve and port timing diagrams
- To test performance of IC engine and compressor
- To estimate optimum cooling temperature and various heat losses of an engine
- To perform dismantling and assembling of an engine

COURSE OUTCOMES: After completion of the course, the student will be able to

CO-1: Illustrate valve and port timing diagrams

CO-2: Analyze performance characteristics of IC engine and compressor

CO-3: Evaluate optimum cooling temperature and prepare the heat balance sheet of an engine

CO-4: Dismantle, identify and understand the functions of various components of an engine

LIST OF EXPERIMENTS:

(Any ten experiments)

1. Valve timing diagram for 4-stroke Diesel engine
2. Valve timing diagram for 4-stroke petrol engine
3. Port timing diagram for 2-stroke petrol engine
4. Performance test on 4-stroke single cylinder Diesel engine
5. Performance test on 4-stroke single cylinder petrol engine
6. Heat balance test on 4-stroke single cylinder Diesel engine
7. Morse test on multi-cylinder petrol engine
8. Optimum cooling temperature test on single cylinder Diesel engine
9. Performance evaluation on computerized Diesel engine
10. Performance test on reciprocating compressor
11. Dismantling, inspection and assembling of multi-cylinder petrol engine
12. Dismantling, inspection and assembling of multi-cylinder Diesel engine
13. Testing of Diesel fuel injector nozzle

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	0	**2**	**1**

(18PC2AE03) METALLURGY AND MECHANICS OF SOLIDS LABORATORY

COURSE PREREQUISITES: Metallurgy and Material Science, Mechanics of Solids

COURSE OBJECTIVES:
- To study the microstructure of different materials
- To understand the changes in microstructure after different heat treatments
- To analyze the various tests to be conducted on engineering materials
- To analyze the importance of tests in evaluating the corresponding mechanical properties

COURSE OUTCOMES: After completion of the course, the student will be able to
CO-1: Identify different materials with microstructure
CO-2: Inspect the microstructure of a given material after heat treatments
CO-3: Evaluate the result of test and comment on the mechanical properties of materials
CO-4: Decide a material and an appropriate test suitable for given application

LIST OF EXPERIMENTS:

METALLURGY (Any five experiments)
1. Preparation and study of the microstructures of metals like Iron, Cu and Al
2. Preparation and study of the microstructures of mild steels, low carbon steels, and high carbon steels
3. Study of the microstructures of cast irons
4. Study of the microstructures of non-ferrous alloys
5. Study of the microstructures of heat treated steels
6. Hardenability of steels by Jominy end quench test
7. Study the microstructure of cutting tools
8. Study the micro structures of stainless steel

MECHANICS OF SOLIDS (Any five experiments)
1. Tension test
2. Bending test - Simply supported and cantilever beams
3. Torsion test
4. Hardness test – Brinell's and Rockwell hardness tests
5. Compression test on a spring
6. Compression test on a cube
7. Impact test
8. Direct shear test

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	2	**0**	**0**

(18MN6HS02) ENVIRONMENTAL SCIENCE

COURSE PREREQUISITES: Basic knowledge of environmental issues

COURSE DESCRIPTION:
Environmental science is the study of patterns and processes in the natural world and their modification by human activity. We as human beings are not an entity, separate from the environment around us, rather we are a constituent seamlessly integrated and co-exist with the environment around us. To understand current environmental problems, we need to consider physical, biological and chemical processes that are often the basis of those problems. The course requires the students to identify and analyse natural and human-made environmental problems, evaluate the relative risks associated with these problems, and examine alternative solutions for resolving or preventing them. This course will survey some of the many environmental science topics at an introductory level, ultimately considering the sustainability of human activities on the planet. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa.

COURSE OBJECTIVES:
- Recognize the impacts of human interventions towards environment
- List out the benefits in creating a sustainable environment
- Sketch out various activities in achieving a cleaner environment
- Emphasize the role of an individual for a better planet to live

COURSE OUTCOMES: After completion of the course, the student will be able to
CO-1: Gain a variety of experiences & acquire a basic knowledge about the environment & its allied problems
CO-2: Interpret the key components in safe guarding the environment
CO-3: Appraise the quality of environment in order to create a healthy atmosphere
CO-4: Familiarize with the individual responsibilities towards green revolution

MODULE 1: INTRODUCTION
Environmental Science: Introduction, Definition, scope and importance.

MODULE 2: AWARENESS ACTIVITIES
Small group meetings about:
- Water management
- Projects Vs Environment
- Generation of less waste
- Promotion of recycle use
- Impact of Science & Technology on Environment
- Avoiding electronic waste

MODULE 3: SLOGAN AND POSTER MAKING EVENT
- Food waste management

- Rain water harvesting
- Climate change
- Green Power
- Water conservation
- Green at work
- Role of IT in environment and human health
- Sustainable development

MODULE 4: EXPERT LECTURES ON ENVIRONMENTAL SCIENCE
- Environmental Impact Assessment
- Industrial waste treatment
- Organic farming/Vertical gardens/Hydroponics

MODULE 5: CLEANLINESS DRIVE
- Indoor air pollution
- Vehicular pollution
- VISUAL pollution
- Waste management at home
- Composting
- Plastic recycling

MODULE 6: CASE STUDIES
- HPCL disaster in Vizag
- Oleum gas leak in Delhi
- Mathura Refinery & Taj Mahal
- Conservation of Hussain Sagar lake
- The Cleanliest city of India-Surat
- Green Buildings in India
- KBR park in Hyderabad (Environmental protection Vs Development)
- Fluorosis
- Ecotourism & its impacts

TEXT BOOKS:
1. Environmental Studies for UG Courses, Erach Bharucha, UGC Publications, Delhi, 2004.
2. Textbook of Environmental Studies, Deeksha Dave, S. S. Katewa, Cengage Delmar Learning India Pvt., 2012.

REFERENCES:
1. Introduction to Environmental Science, Y. Anjaneyulu, BS Publications, 2004.
2. Environmental Studies by Anubha Kaushik & C. P. Kaushik, 4th Edition, New Age International Publishers.