Semester VII (Fourth Year]
Branch/Course Mechanical Engineering

Course Code	Course Title	L	T	P	Credits	Branch			
100701	Induction Program	3	0	0	0	102	TH	0	0
102701	Internal Combustion Engines	3	0	0	3	102	TH	70	30
1027xx	Open Elective- II	3	0	0	3	102	TH	70	30
1027xx	Program Elective - III	3	0	0	3	102	TH	70	30
1027xx	Program Elective- IV	3	0	0	3	102	TH	70	30
102701	Internal Combustion Engines	0	0	3	1.5	102	PR	30	20
100709	Project-I	0	0	12	6	102	PR	30	20
100702	Summer Entrepreneurship-III	0	0	16	8	102	PR	30	20

Mechanical Engineering

102702	Refrigeration and Air Conditioning	3L:0T:3P	4.5 credits

Objectives:

1. To familiarize with the terminology associated with refrigeration systems and air conditioning
2. To understand basic refrigeration processes
3. To understand the basics of psychometric and practice of applied psychometrics
4. To acquire the skills required to model, analyses and design different refrigeration as well as air conditioning processes and components.

Course Content:

Module: 1

Air refrigeration system: Refrigeration machine, heat pump, coefficient of performance, ideal refrigeration cycle, Bell – Coleman, refrigeration cycle, open and closed systems, application of air-refrigeration in air-crafts. **(Lectures 6)**

Module:2

Various compression systems: Simple vapour compression refrigeration cycle, merits and Refrigerants demerits of this system over air refrigeration system, factors affecting the performance of a vapour compression refrigeration system, sub cooling and superheating of vapour, wet and dry compression, multistage vapour compression system, intercooler, flash chamber, accumulator and heat exchanger. **(Lectures 8)**

Module: 3

Vapour absorption system: Simple and modified vapour absorption refrigeration system, Electrolux refrigerator, COP of heat operated refrigeration system. **(Lectures 5)**

Module: 4

Special refrigeration system, absorption, cascade, vortex, thermoelectric and steam jet refrigeration system. **(Lectures 4)**

Module: 5

Refrigerants: classification and nomenclature of refrigerants, primary and secondary refrigerants, properties of some common refrigerants, physical, chemical and thermodynamics properties, selection of refrigerants, leakage of refrigerants and methods of detection.

(Lectures 3)

Module:6

Psychometry: Properties of air vapour mixture, wet bulb, dew point & dry bulb temperatures, humidity, specific humidity, humidity ratio, degree of saturation, relative humidity, total heat psychometric relation, psychometric charts and its uses, psychometric processes evaporative cooling.

(Lectures 5)

Module: 7

Air conditioning: General principle and requirement for comfort and air conditioning, thermodynamics of human body, estimation of heating and cooling loads, capacity of cooling coils, humidification and dehumidification unit and conditioner, central air conditioner, year around air condition, humidity and temperature control, industrial application of air conditioning system

(Lectures 10)

Module: 8

Concept of enthalpy potential - Air washers, Cooling towers, Evaporative condensers, Cooling and dehumidifying coils. **(Lectures 4)**

Course Outcomes:

A student who has done the course will have a good understanding of the working principles of refrigeration and air-conditioning systems.

Note: Refrigeration Data Books are permitted for examination.

Text Books:

1. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.
2. Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill, 1986.
3. Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000.
4. Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition,Prentice Hall, 1998.

Practical:

1. Determination of the COP of a vapour compression system.
2. Determination of the COP of vapour absorption apparatus.
3. Determination of the COP of a heat pump.
4. To find the performance parameter of cooling tower.
5. To study various components of room air conditioner and determine its performance for

different psychometric condition.

6. Determination of COP of an Electrolux refrigerator.
7. To study the compressor and throttling valve used in refrigerator

Objectives:

To provide an overview of how computers can be utilized in

102703	Computer Aided Design	3L:0T:3P	4.5 credits

mechanical component design

Contents:

Module: 1

Fundamentals of Computer Graphics- Product cycle, sequential and concurrent engineering, Computer Aided Design, CAD system architecture, computer graphics, Coordinate systems, 2D and 3D transformations, viewing transformation. **(Lectures 10)**

Module: 2

Geometric Modeling- representation of curves, Hermite curves, Bezier curves, B-spline curves, rational curves, Techniques of surface modelling, surface patch, Coons and bicubic patches, Bezier and B-spline surfaces, Solid modelling techniques, CSG and B-rep.

(Lectures 10)

Module: 3

Visual realism- hidden line-surface-solid removal algorithms, shading, colouring, computer animation. **(Lectures 8)**

Module: 4

Assembly of parts- assembly modelling, interferences of positions and orientation, tolerance analysis, mass property calculations, mechanism simulation and interference checking CAD standards- Graphical Kernel System (GKS), standards for vexchange images, Open Graphics Library (OpenGL), Data exchange standards- IGES, STEP, CALS etc., Communication standards. **(Lectures 12)**

Course Outcomes:

Upon completion of this course, the students can use computer and CAD software for modelling mechanical components

Text Books:

1. Ibrahim Zeid, Mastering CAD CAM, Tata McGraw Hill Publishing Co.2007.
2. C. McMohan and J. Browne, CAD/CAM Principles, II edition, Pearson Education,1999.
3. W. M. Neumann and R.F. Sproul, Principles of Computer Grahics, McGraw Hill,1989.
4. D. Hearn and M.P. Baker, Computer Graphics, Prentice Hall Inc.,1992.

Practical:

1. Initiating the Graphics Package; Setting the paper size, space; setting the limits, units; use of snap and grid commands.
2. Drawing of primitives (Line, arc, circle, ellipse, triangle etc.)
3. Drawing a flange.
4. Drawing a bushing assembly.
5. Dimensioning the drawing and adding text.
6. Setting the layers and application of layers.
7. Isometric and Orthographic projections.
8. Viewing in three dimensions.
9. Removal of hidden lines – Shading and Rendering.

102704	Finite Element Analysis	3L:0T:3P	4.5 credits

Objectives:

1. To illustrate the principle of mathematical modeling of engineering problems
2. To introduce the basics and application of Finite Element Method

Contents:

Module: 1

Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method. **(Lectures 8)**

Module: 2

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order beam equation, transverse deflections and naturalfrequencies. **(Lectures 12)**

Module: 3

Two dimensional equations, variational formulation, finite element formulation, triangular elements- shape functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements. **(Lectures 12)**

Module: 4

Natural coordinate systems, isoparametric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, introduction to FE software. **(Lectures 8)**

Course Outcomes:

Upon completion of the course, students will understand the FEM formulation and its application to simple structural and thermal problems

Text Books:

1. Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill,2005.
2. Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi,2007.
3. Rao S.S., The Finite Element Method in Engineering, 3rded., Butterworth Heinemann, 2004.
4. Chandraputla & Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall, 1990.

Practical:

Use these software for experiments: ANSYS, SIMULIA, ABAQUS, MATLAB etc.

1. Force and stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi-symmetric components.
5. Thermal stress and heat transfer analysis of plate.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of beams.

102705	Automobile Engineering	3L:0T:3P	4.5 credits

Objectives:

To understand the construction and working principle of various parts of an automobile

Contents:

Module: 1

Types of automobiles, vehicle construction and layouts, Car body Style, chassis, frame and body, vehicle aerodynamics, IC engines-components, function and materials, variable valve timing (VVT), Front engine front wheel drive, Front engine Rear wheel drive, foure wheel drive.

(Lectures 6)

Module: 2

Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS). **(Lectures 6)**

Module: 3

Transmission systems, clutch types, cone clutch, Single plate, multi plate, diaphragm spring & centrifugal clutch, electromagnetic clutch & construction, gear boxes- manual and automatic gear shift mechanisms, over drive principles, transfer box, Transaxles, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive**.** **(Lectures 8)**

Module:4

Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, constructional details & characteristics of Leaf spring, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control. **(Lectures 8)**

Module: 5

Caster, Camber, King pin inclination Toe in Toe out, Full Floating, three quarter floating &semi Floating rear axles. **(Lectures 5)**

Module: 6

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells.

(Lectures 7)

Course Outcomes:

Upon completion of this course, students will understand the function of each automobile component and also have a clear idea about the overall vehicle performance.

Text books:

1. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.
2. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.
3. Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.
4. Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998.

Practical:

1. To study and prepare report on the constructional details, working principles and operation of the Automotive Clutches.
2. To study and prepare report on the constructional details, working principles and operation of the Automotive Transmission systems.
3. To study and prepare report on the constructional details, working principles and operation of the Automotive Drive Lines & Differentials.
4. To study and prepare report on the constructional details, working principles and operation of the Multi-cylinder: Diesel and Petrol Engines.
5. To study and prepare report on the constructional details, working principles and operation of the Fuels supply systems.
6. To study and prepare report on the constructional details, working principles and operation of the Engine cooling & lubricating Systems.
7. To study and prepare report on the constructional details, working principles and operation of the Automotive Suspension Systems.
8. To study and prepare report on the constructional details, working principles and operation of the Automotive Steering Systems.
9. To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems.