7th Semester Mechanical Engineering

Course No.	*Course Name*	*Credits*	*L*	*T*	*P*
MEC 701	Basic Fracture Mechanics	3	2	1	0
MEC 702	Measurement and Instrumentation	4	3	1	0
MEC 703	Industrial Engineering-II	4	3	1	0
MEC 704	Applied Thermodynamics- II	4	3	1	0
MEC 705	Computer Applications in Mech. Engg. (CAME)	3	2	1	0
MEC 703P	Industrial Engineering- II Lab.	1	0	0	2
MEC 705P	CAME Lab.	1	0	0	2
MEC 706	Final Year Project	3	0	0	6
MEC 707	Practical Training & Professional Viva	2	0	0	0
	Total of Credits & LTP	**25**	**13**	**05**	**10**

Course No.: MEC 701 **BASIC FRACTURE MECHANICS** **C L T (3 2 1)**

COURSE OUTCOMES:

1. **Evaluate fracture toughness data for stationary and growing cracks using LEFM techniques.**
2. **Analyse the crack growth in materials subjected to both cyclic and static loads.**
3. **Identify and describe different failure mechanisms in materials and engineering structures.**
4. **Explain hjow acrack affect an engineering structure and describe the state of stress and strain that may arise in the vicinity of thje crack front in different matrerials**

UNIT I

Summary of basic problems and concepts in fracture, a crack in a structure, crack tip stresses, The Griffith criterion, crack opening displacement criterion, crack propagation.

Mechanisms of fracture and crack growth, cleavage fracture, ductile fracture, fatigue cracking, Environmental assisted cracking, service failure analysis.

UNIT II

The elastic crack-tip stress field, Airy stress function, complex stress function, solution to crack problems, the effect of finite size, Some special cases, elliptic cracks The energy principles, The concept of energy release rate, The criterion for crack growth, The crack resistance, The concept of J-integral.

UNIT III

Crack-tip plastic zone, Irwin's plastic zone correction, The Dugdale approach, Plane stress versus plane strain, plastic constraint factor, The thickness effect, application of von Mises and Tresca yield criteria to obtain plasticityeffected regions, Dynamics and crack arrest, Crack speed and kinetic energy, the dynamic stress intensity and elastic energy release rate, principles of crack arrest.

Text Book:

1. Anderson T.L., "Fracture Mechanics Fundamentals and applications",*CRC, Taylor & Francis, 2005.*

Reference Book:

1. Janssen,M.J., Zuidema, J., Wanhill R.J.H., " Fracture Mechanics", *Spon Press, , 2004.*

Course No.: MEC702 MEASUREMENT AND INSTRUMENTATION C L T (4 3 1)

COURSE OUTCOMES:

1. **Identify advantages and limitations of measuring systems and comment on their suitability for a particular application**
2. **Explain some of the typical methods employed to measure motion, temperature, force, pressure and flow.**
3. **Describe various static and dynamic charateristics of instruments and explain their effects on instrument behaviour**
4. **Eplain the principle of sensors tramsducers for a particular measurement instrument.**

UNIT I

Measurement and Instrumentation; definitions, significance, Fundamental methods, generalized measurement system, Functional elements, Types of input quantities, standards, calibration, uncertainty, Errors, Classification of instruments, Input-output configuration, Interfering and modifying inputs, methods of correction, Generalized performance characteristics, static characteristics, static calibration, Dynamic characteristics, zero and first order instruments, time constant, Second-order instruments, transient response characteristics. Relative and absolute motion devices, relative displacement, Resistive potentiometers, bridge circuit, LVDT, Variable inductance and variable capacitance pick-ups, Piezoelectric transducers, fibre optic displacement transducer, Resistance strain gage, Relative velocity-translational and rotational, Mechanical revolution counters and timers, stroboscopic method, Moving coil and moving magnet pickups, DC and AC tachometers, Eddy current drag-cup tachometer, acceleration measurement.

UNIT II

Hydraulic and pneumatic load cells, flapper nozzle principle, Force transducers with elastic members, Proving ring transducer, cantilever beam transducer, electromagnetic balance, Dynamometers – Absorption, driving and transmission type, reaction forces in shaft bearings, prony brake, eddy current brake dynamometer, Instruments for high, mid and low pressure measurement, dead weight and null type, Elastic element gages, Differential pressure cell, high pressure measurement, Low pressure measurement –, Pirani gages & McLeod pressure gauge.

UNIT III

Orifice meters, Venturimeter, Pitot tube, Flow nozzle, Variable area meters, rotameter, design and accuracy, Positive displacement flow meter, turbine flow meter, Electromagnetic flow meter, ultrasonic flow meters, Temperature sensing techniques, liquid-in-glass and bimetallic thermometers, Pressure thermometers, electrical resistance thermometers, Thermistors, Thermocouples, thermopiles, Radiation pyrometers, Optical pyrometer.

Text Book:

1. Beckwith, B., "Mechanical Measurements", 6th edition, *Pearson Education Int. ,2008.*

Reference Book:

1. Nakra B.C. "Instrumentation, Measurements & Analysis", 2nd edition, *Tata*

McGrawHill, N.Delhi, 2008.

2. Doeblin, E.O., "Measurement systems",5th edition, *McGraw Hill, New Delhi, 2004.*

Course No.: MEC 703 **INDUSTRIAL ENGINEERING - II** **C L T (4 3 1)**

COURSE OUTCOMES:

1. **Grasp the concept of organizational design with emphasis on organization principles & work design.**
2. **Analyse & design facility location and layout using various techniques and softwares.**
3. **Demonstrate the ability to use the methods of statistical quality control and process control for effective designing of Industrial Quality Monitoring Systems.**
4. **Demonstrate the ability to apply the techniques of material management and inventory control for effective designing and systematic implementation of various MM methods and inventory systems in manufacturing set-up.**

UNIT I

Factory organization**:** Introduction to Plant organization, Principles of Organizational structure, Organization charts, Types of Organizations, Developing an organization structure, Results of good organization,, Informal organization, advantages and disadvantages.

Location and Layout analysis: Introduction to Facility location problems, Factors affecting the plant location. Break even analyses and their application, Subjective, qualitative and semi-Quantitative techniques of facility location, Single facility Location problem, Minimax Location problem, Gravity problem and their applications. Line balancing, Introduction to facility layout and their objectives, Classification of Layouts, with advantages and disadvantages of each, Layout design procedures(CRAFT,CORELAP,ALDEP), Material handling systems, Make or Buy decisions, Planning and control of Batch Production,. Characteristics of Batch Production, Determination of Batch size, Minimum Cost batch Size, Maximum Profit Batch size, Sequencing and scheduling for Batch Production, Line of Balance technique.

UNIT II

Inspection and quality control**:** Concept and Definition of Quality, Concepts of Inspection and quality control, Objectives of inspection, Function of Inspection and their types, Concept of statictical quality control (SQC), Process variation, Sampling inspection. Concepts and types of Control charts, Acceptance sampling, application of control charts and sampling plans.

UNIT III

Materials management and inventory control**:** Integrated materials management and their components, Functions and objectives of material management, Introduction and concepts of Inventory management, Purchase model with instantaneous replenishment and without shortage, Manufacturing model without shortages, Purchase model with shortages, Manufacturing model with shortages, Probabilistic inventory concepts with lead time., Selective inventory management- ABC , FSN, VED analyses.

Text Book:

1. Everett, E.A., Ronald J.E, "Production and Operations Management" *Prentice Hall of India, 5th edition, New Delhi, 2001.*

Reference Books:

1. Claude, S.G., "Management for Business & Industry" *Prentice Hall of India*, New Delhi, 2000.
2. Everett, E.A., Ronald J.E, "Production and Operations Management", *Prentice Hall of India, 5th Edition, New Delhi, 2001*.
3. Grant, E.L; Leavenworth R.S, "Statistical Quality Control", *Tata Mcgraw Hill, 7th Edition*, New Delhi, 1996.
4. Apple, J.M, "Plant Layout & Material Handling", *JohnWiley & Sons, New York.*
5. Maynard, Industrial Engineering Hand Book, *McGraw Hill, New York.*

Course No.: MEC 704 APPLIED THERMODYNAMICS- II C L T (4 3 1)

COURSE OUTCOMES:

1. **Define the concept of gas Dynamics and different energy equations.**
2. **Analyze the working and operations of the gas power plants.**
3. **Analysis of operations and design centrifugal air compressor.**
4. **Design and analyze the axial air compressor.**

UNIT I

Gas dynamics, Definitions and basic relations, Energy equation, rate equations for a control volume, Isoentropic flow with variable area, wave motion, Flow with normal shock waves, Flow in Constant area ducts with friction, Flow in constant area ducts with heat transfer, Centrifugal compressor, Energy transfer in compressors and turbines, Euler's equation. Principles parts and description of centrifugal compressor, impeller diameter, number of blades, velocity diagram, sprewhirl (??) slip, factor work input, factor pressure coefficient, compressor efficiency.

UNIT II

Axial flow compressor, Stage velocity diagram, stage pressure ratio and number of stages, degree of reaction blade and stage efficiency, poly tropic and isentropic efficiency surging, Gas Turbines, Ideal gas turbine cycle, condition for maximum output, actual gas turbine cycles, reheating and regeneration velocity diagram for a stage, stage pressure ratio and number of staged polytropic efficiency, isoentropic efficiency, Jet propulsion, Turbojet cycle, net thrust, specific thrust, thermal efficiency of turbojet engine, propulsive efficiency, effect of forward speed.

UNIT III

Applications of Refrigeration and Air-conditioning, Thermal Principles for Refrigeration, Vapor Compression System, Reversed Carnot Cycle, Survey of Refrigerants, Designation of Refrigerants, Selection of Refrigerants, Thermodynamic Requirements, Multistage compression, multi-evaporator system, cascade systems, systems practices for multistage systems, Reciprocating Compressors, Rotary screw compressors, Vane compressors, Centrifugal compressors, Condensers, Heat Transfer in Condensers, Evaporators, Heat Transfer in Evaporators, Extended surface Evaporator, Cooling and Dehumidifying coils, Automatic or constant-pressure expansion valve, Psychometric properties, Wet bulb temperature, Psychometric chart, mixing process.

Text Book:

1. Cohen H, Rogers G.F.C.,"Gas turbine Theory", *Pearson Education, ,2001*.
2. Yahya, S.M., "Fundamentals of Compressible flow", *New Age India, Place,* 2002.
3. Arora C.P., "Refrigeration and Airconditioning", *McGraw Hill, New Delhi, 1990.*

Reference Books:

1. Stoeker,W.F., " Refrigeration and Air conditioning", *McGraw Hill, , 1990.*

2. Shapiro A.H., “The Dynamics and Thermodynamics of Compressible Fluid Flow”, *Ronald Press, 1953*.

Course No.: MEC 705 COMPUTER APPLICATIONS IN MECH. ENGG. (CAME)

C L P (3 2 1)

COURSE OUTCOMES:

1. **Able to solve non-linear equations using, R.F, Newton Rapson methods.**
2. **Able to solve linear system of equations using Gauss elimination, Gauss-Jourdan, Gauss siedel & LU decomposition**
3. **Able to use interpolation formulas; and linear & non linear curve fitting.**
4. **Able to use numerical differentiation & integration methods. Solve ODEs & PDEs using numerical methods.**
5. **Able to develop computer programmes for the above methods and interpret them graphically.**

UNIT I

Overview of C++, Flow charts. Computer languages. Constants and variables. Arithmetic expressions. Input/ output, control and the Do and for statements. Introduction to programming.

Types of errors. Computational algorithms and computer arithmetic. Iterative methods. Solution of equations: Bisection method, Regula-falsi method, Newton Raphson method. Solution of linear system of equations: Gauss elimination, Gauss-Jordan, Gauss- Siedel method, LU decomposition.

UNIT II

Interpolation and approximation of functions, Newtons forward formula (equal and unequal intervals) Curve fitting (straight line, nonlinear, exponential) differentiation, integration (Simpson's rule, Weddle's) and program.

UNIT III

Numerical solution of ordinary different equations. Runge- Kutta methods, Types of PDEs, boundary value problems, solution of parabolic PDEs using finite differences and program.

- Examples to be taken from Mechanical engineering applications.

Text Book:

1. Sastry,S. " Numerical Methods", *Printice Hall of India, New Delhi*.

Reference Books:

1. Lafore , G, “C++ Programming”, *Galgotia publishers,New Delhi, 2001.*
2. Veerarajan, “ Numerical Methods”, *Tata Mc-GrawHill, New Delhi, 2000.*

MEC 703 P INDUSTRIAL ENGINEERING-II LAB. C P(1 2)

COURSE OUTCOMES:

1. **Present a numerical and graphical characterization of quantitative data assuming the quantitative data are observations from a normal distribution to compute the Probability of specific numerical outcomes. Construct and interpret normal Probability plots of quantitative data.**
2. **Construct, implement and interpret X-bar and R control charts for variables from Standards and from data; and demonstrate how to use the corresponding OC curves.**
3. **Construct, implement and interpret p, c, and u control charts for attributes from Standards or data; and demonstrate how to use the corresponding OC curves.**
4. **Demonstrate and simulate layouts to determine optimum material flow rate and cycle time of a job using witness software**

1. To study the layout of a shop in an organization and draw existing and proposed layouts.
2. To measure the variable characteristics (diameter of pins, with micrometer) and prepare a frequency histogram. Calculate values of X bar and sigma.
3. Verify that when random samples are taken from a lot with a certain percentage of defective, same %age lands to appear in random sampling by using Shewart's kit.
4. Simulate an inspection situation with the help of a Schewhart's bowl and plot X bar, and R charts using computed data.
5. To conduct Process capability study of a machine tool and to specify the tolerances for a job.
6. To verify the theorem "the standard deviation of the sum of any number of independent variables is the square root of the sum of the squares of the S.Ds of the independent variable. Determine statistically, the permissible tolerance of mating components, when the tolerance of the assembly is given.
7. To draw control chart for percent defectives after inspecting a sample and sorting out the defective units.

MEC 705P **CAME LAB** **C P (1 2)**

COURSE OUTCOMES:

1. **Construct, implement and interpret p, c, and u control charts for attributes from**
2. **Standards or data; and demonstrate how to use the corresponding OC curves.**
3. **Demonstrate and simulate layouts to determine optimum material flow rate and cycle time of a job using witness software**
4. **Able to develop computer programmes for the above methods and interpret them graphically.**

Develop programme and algorithm for:

1. Bisection method
2. Regula - Falsi method
3. Newton Raphson method
4. Gauss Elimination method
5. Gauss Jordon method
6. Gauss Seidel method
7. Integration by trapezoidal method
8. Integration by Simphson rule (1/3 and 3/8)
9. Solution of ordinary differential equations and Partial differential equations by

   a) R.K methods
   b) Solution of Parabolic partial differential equation.