

# Final Year

## FALL SEMESTER

### **IM-405    Finite Element Analysis**

#### **Introduction:**

The early use of Finite Elements, matrix forces method, matrix stiffness method, interim period, variational principles and Finite Elements, recent developments

#### **Variational Formulation and Approximation:**

Boundary and Initial-Value problems, gradient and divergence theorems, functional, variational symbol Variational formulation of boundary-value problem, Variational Method of Approximation, Ritz method, method of weighted residuals, time-dependent problems

#### **Finite Element Analysis of One-dimensional Problems:**

Basic Steps in FEA; Modeling, Discretization, Connectivity of Elements, Imposition of Boundary Conditions, Solutions & Post Processing; Applications to Heat Transfer, Fluid Mechanics, & solid Mechanics Problems.

#### **Finite Element Error Analysis:**

Approximation Errors, Various Measures of Errors, Convergence of Solutions, Accuracy of Solutions.

#### **Numerical Integration & Computer Implementation:**

Isoperimetric Formulations, Numerical Integration, Natural Coordinates, Computer Implementation (Pre-processor, Processor, and Post-processor)

#### **Interpolating Functions, Numerical Integration & Modeling Considerations:**

Interpolating Techniques; Triangular, Rectangular, & Serendipity Elements; Coordinate Transformation; Integration on a Master Element; Modeling, Mesh Generation, Load Representation.

#### **Plane Elasticity:**

Assumptions of Plane Elasticity; Basic Equations, Weak Formulations; Principle of Virtual Displacement in Matrix Form; Finite Element Model, Matrix & Weak Form Model; Evaluation of Integrals

### **IM-402    Computer Aided Manufacturing**

#### **Conventional Numerical Control:**

Introduction, principles of Numerical Control, Hardware for Numerical Control, NC positioning systems, NC motion control systems, applications of numerical control, economics and justification.

### **NC Part Programming:**

Manual part programming, computer assisted part programming, Lathe CAM Designer, Mill CAM, NC programming with interactive graphics.

### **Computer Controls in NC:**

Problems with conventional NC, NC controller of technology, computer numerical control, direct numerical control, adaptive control machining systems, trends and new developments in NC.

### **Group Technology and Process Planning:**

Part families, methods for developing part families; parts classification and coding, Hierarchical code, Attribute code, Hybrid code, introduction to various available classification and coding systems, Selecting a coding system, production flow analysis, benefits of group technology, machining cells. The role of process planning in CAD / CAM integration, Approaches to process planning: Manual approach, Variant approach, Generative approach; introduction to various process planning systems.

### **Programmable Logic Controllers (PLC's):**

Functions of controllers, control devices, Programmable Logic Controllers: relay device components, switch, relay, counters, timers, relay logic, Programmable Controller Architecture: processor, memory, input /output, power supply, peripherals, Programming a Programmable Logic Controller: ladder diagram, ladder logic, timers and counters, programming examples.

### **Design for Manufacturing (DFM):**

The meaning of DFM, schemes for DFM, axiomatic design, DFM guidelines, design for assembly, Taguchi method for Robust design, manufacturing process design rules, failure mode and effects analysis, summary of DFM tools.

## **MG-450 Principles of Supply Chain Management**

Introduction to logistic & supply chain management, Internal and external supply chain, Operational issues, Supply chain modeling, Inventory management, Value of information,

International supply chain management, Coordinate product and supply chain management customer value, Information technology for supply chain management, Decision support systems for supply chain management

## **IM-XXX Elective**

## **SPRING SEMESTER**

### **IM-417 Health, Safety & Environment**

#### **Safety Management:**

Understanding accident and hazard, Hazard control and loss control, Company policy and management responsibilities, Direct and indirect cost, Accident causes and their control, Principles and processes of lost control, Knowledge of existing safety codes and standards

#### **Hazard and Risk**

Hazards and identification, Risk Assessment, Risk Control

#### **Accident Prevention and Control:**

Fire safety, Electrical Safety, Safety in boilers and unfired pressure vessels and high pressure systems, Safety in material handling and storage, Safety in production operations

#### **Industrial Hygiene and Workers Protection:**

Understanding industrial hygiene, Various hazards encountered in workplace, Types of personal protective equipment (PPE), Availability in market their design standards and selection criteria.

#### **Process Safety Management:**

Development of facility operation and procedures, Analysis of process hazard, Permit to work systems, Hazard communication (Material Safety Data Sheet), Chemical inventory record, Accident reporting and investigation, OHSAS 18001:1999

#### **Environment Management:**

Environment pollution, Air emission management, Waste management, Waste water treatment and control, Soil and ground water protection, Introduction to Pakistan Environment Protection Act 1997 and National Environmental Quality Standards, Key elements of ISO 14000.

## **IM-413 Plant Engineering**

### **Thermal Power Plants:**

Basic principles and cycles used; Steam power plants; Diesel power plants; gas power plants; combined heat and power generation.

### **Internal Combustion Engines:**

Basic Internal Engine Types: Spark ignition engines; Compression Ignition engines; speed and load control; supercharging. Idealized cycle and processes; Otto cycle; Diesel cycle Fuels, high and heavy fuel oil

### **Steam Generators and Turbines:**

Properties of Steam; Enthalpy and entropy diagram; Rankine cycle, Steam Power Plant: Boilers; Feedwater pump; Air Pre-heaters; Economizers; Super-heaters; Condensers. Boiler Types: Fire tube and water tube designs. Steam turbines; impulse and reaction types; back-pressure and extractive turbines

### **Air-conditioning and Ventilation:**

Principles of air-conditioning; Comfort and industrial air-conditioning; refrigeration equipment; primary and secondary refrigerants; ventilation equipment Psychometric chart and its use; calculation of the simple air-conditioning system Temperature and humidity control; pneumatic, electric and hydraulic systems

## **HS-403 Entrepreneurship**

### **Understanding the Entrepreneurship Mind-Set:**

The Revolutionary Impact of Entrepreneurship The Individual Entrepreneurship Mind-Set, Corporate Entrepreneurship Mind-Set. The Social and Ethical Perspectives of Entrepreneurship,

### **Launching Entrepreneurial Ventures:**

Creativity and Innovation, Methods to Initiate Ventures, Legal Challenges in Entrepreneurship, The Search for Entrepreneurship Capital,

### **Formulation of Entrepreneurial Plan:**

The Assessment Function with Opportunities, The Marketing Aspects of New Ventures, Financial Statements in New Ventures, Business Plan preparation for New Ventures,

### **Strategic Perspectives in Entrepreneurship:**

Strategic Growth in Entrepreneurship, Valuation Challenge in Entrepreneurship, Final Harvest of a New Venture

## **MT-441    Advanced Mathematical Techniques**

### **Complex Variable:**

Limit, continuity, zeros and poles of a complex function. Cauchy-Reimann equations, conformal transformation, contour integration.

### **Error Analysis:**

Types of errors (relative, Absolute, inherent, round off, truncation), significant digits and numerical instability, flow chart

Use any Computational tools to Analysis the Numerical Solutions.

### **Finite Difference:**

Functions of operators, difference operators and the derivative operators, identities Linear homogeneous and non-homogeneous difference equations Numerical Differentiation, Forward Difference Method, Backward Difference Method, Central Difference Method.

### **Interpolation & Curve Fitting:**

Lagrange's, Newton, Hermit, Spline, least squares approximation. (Linear and non-linear curves) With numerical problem in engineering

### **Numerical Integration & Differentiation:**

Computation of integrals using simple Trapezoidal rule,  $\frac{1}{3}$  th Simpson's rule,  $\frac{3}{8}$  th Simpson's rule, Composite Simpson's and Trapezoidal rules, computation of solutions of differential equations using (Euler method, Euler modified method, Runge Kutta method of order 4).

### **Improper integrals:**

Definitions, Types of improper integral and their convergence

### **Elliptic Integrals:**

Introduction and identification of elementary elliptic integrals of first, second and third kinds Simple applications

## **IM-409 Manufacturing Engineering Project**

Selected problems requiring design, manufacturing, development of problem specific software, preparation of drawings, fabrication of prototype / models and laboratory experimentation shall be assigned to individual students or groups of students. Grading shall be based on the reports produced by individual students and their critical evaluation through an oral examination.

# Electives

## **IM-416 Management Information Systems**

### **Introduction:**

Overview of System and Sub-systems, Information Systems, Relevance of Information Systems to organizational decision making, Information Systems and Manufacturing Environment Responsibilities of an Industrial Engineer from MRP to ERP and beyond.

### **Tools and Technologies:**

Data Flow Diagrams, Functional Flow Diagrams, System Flow Charting, UML Diagrams, Bar Coding Technology, RFIDs, Formal Documentation and Presentation Formats.

### **Information and Data Base Management Systems:**

Data Handling Procedures, Database; their Types and Design Issues including Modeling (ER Diagram etc.) and Normalization, Data Base Management Systems, Data Base Software, Client-Server vs. Distributed Computing, Methods of Data Collection, System Development Life Cycle (SDLC), Feasibility Study Considerations, Effects and Usages of Internet in Manufacturing Industry.

## **IM-418 Condition Monitoring**

### **Mechanical Vibration Fundamentals**

Harmonic motion, Single & multi degree of Freedom (dof), Free and forced vibration, Damped and un-damped vibration, Rotational unbalance, Foundation force and transmissibility, Transverse Vibration, Whirling of Shafts, Self-excited vibration

### **Condition Monitoring Basics**

Maintenance strategies, Condition based maintenance, Key features of Condition monitoring, When to use and how to implement condition monitoring

### **Vibration Measurement & Control**

Vibration measurement system, Transducers and instrumentation, Vibration monitoring, Spectral Analysis and Control

### **Condition Monitoring Diagnostic Techniques**

Monitoring of vibration, Wear-Debris Analysis, Oil and Lubricant analysis Oil/ debris, Current, Conductivity, Insulation, Performance, Thermography, Acoustic and ultra-sonic emission, Corrosion and Visual & manual inspection

### **Condition Monitoring Case Studies**

Case studies related to static and rotating industrial equipment such as induction motors, Rotor dynamic pumps and reciprocating machines

## **IM-419 Project Management**

### **Project Management Framework:**

Definition of projects and Project Management, Projects versus Operations, Project Management versus Classical/Operations Management,

Evolution of Project Management, Project Life Cycle and its differences with Product Life Cycle, Forms of Organizational Structures and their impact on Project Management, Project Management Methodology, Project Initiation and Project Charter, Project Planning Process, Types of Plans. Project Scope Management: Scope Statement, Work Breakdown•

### **Structure, Work Packages**

### **Project Significant: Listing Activities.**

Developing a Network, Types of Network Diagrams, Duration Estimation, CP.V/PERT and their differences, Constructing the Critical Path, Critical Path Analysis, Gantt Charts, Project Schedule Compression Techniques, Project Crashing.

### **Project Budgeting:**Creating a Project

Budget, Top-Down Budgeting, BottomUp Budgeting, Activity-Based Costing. Project Execution Monitoring and Closing: Project Execution Process,

Issues during Project Monitoring, Project Control, Project Closing Process, Lea sons Learned