DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

SYLLABI OF COURSES FOR B.E. (INDUSTRIAL AND MANUFACTURING ENGINEERING) DEGREE PROGRAMME

FIRST YEAR

FALL SEMESTER

Course Code	Course Title	Credit Hours		
		Th	Pr	Total
MT-114	Calculus	3	0	3
ME-101	Engineering Mechanics	3	1	4
EE-122	Basic Electricity and Electronics	3	0	3
ME-104	Workshop Practice	0	2	2
HS-105/ ES-127	Pakistan Studies OR Pakistan Studies for Foreigners	2	0	2

SPRING SEMESTER

Course Code	Course Title	Credit Hours		
		Th	Pr	Total
PH-122	Applied Physics	3	1	4
EA-111	Functional English	2	0	2
ME-111	Engineering Drawing	2	1	3
IM-101	Computer Applications in Engineering	2	1	3
IM-105	Thermo fluids	3	1	4

SECOND YEAR

FALL SEMESTER

Course Code	Course Title	Credit Hours		
		Th	Pr	Total
IM-208	Materials Engineering	3	1	4
IM-209	Mechanics of Materials	3	1	4
IM-203	Manufacturing Processes	3	1	4
MT-252	Introduction to Probability & Statistics	3	1	4
ES-205/ ES-209	Islamic Studies OR Ethical Behaviour	2	0	2

SPRING SEMESTER

Course Code	Course Title	Credit Hours		
		Th	Pr	Total
MT-225	Linear Algebra & Ordinary Differential Equations	3	0	3
MF-303	Applied Economics for Engineers	3	0	3
IM-211	Machine Design	3	1	4
IM-212	Computer Aided Engineering Design	2	1	3
IM-213	Metrology and Quality Control	3	1	4
EA-200	Community Service	-	-	NC

THIRD YEAR

FALL SEMESTER

Course Code	Course Title	Credit Hours		
		Th	Pr	Total
EA-304	Business Communication & Ethics	3	0	3
IM-303	Production Management	3	1	4
MT-333	Advanced Calculus & Fourier Analysis	3	0	3
IM-312	Applied Thermo Fluids	3	1	4
IM-310	Tool Design	3	1	4

SPRING SEMESTER

Course Code	Course Title	Credit Hours		
		Th	Pr	Total
IM-308	Operations Research	3	1	4
IM-307	Advanced Manufacturing Processes	3	1	4
IM-408	Automation & Robotics	3	1	4
IM-411	Methods Engineering	2	1	3
IM-320	Modeling and Simulation	2	1	3
##-###	Foreign Language-I	-	-	NC

FINAL YEAR

FALL SEMESTER

SPRING SEMESTER

Course Code	Course Title	Credit Hours			Course Code	Course Title	Credit Hours		
		Th	Pr	Total			Th	Pr	Total
IM-405	Finite Element Analysis	3	1	3	MG-481	Entrepreneurship	3	0	3
IM-402	Computer Aided Manufacturing	3	1	4	IM-417	Health, Safety & Environment	2	1	3
MG-450	Principles of Supply Chain Management	3	0	3	MT-441	Advanced Mathematical Techniques	3	0	3
IM-##	Elective Course	3	1	4	IM-413	Plant Engineering	3	1	4
IM-409	Manufacturing Engineering Project*	0	3	3	IM-409	Manufacturing Engineering Project	0	3	3
##-###	Foreign Language-II	-	-	NC					

Elective Courses

IM-416	Management Information System	IM-420	Basics of Additive Manufacturing
IM-418	Condition Monitoring	IM-421	Smart Manufacturing Systems
IM-419	Project Management	IM-422	Ergonomics in Workplace Design

MT 114 CALCULUS

Set and Functions

Define rational, irrational and real numbers; rounding off a numerical value to specified value to specified number of decimal places or significant figures; solving quadratic, and rational inequalities in involving modulus with graphical representation; Definition of set, set operations, Venn diagrams, DeMorgan's laws, Cartesian product, Relation, Function and their types (Absolute value, greatest integer and combining functions). Graph of some well-known functions. Limit of functions and continuous and discontinuous functions with graphical representation.

Differential Calculus

Differentiation and Successive differentiation and its application: Leibnitz theorem. Taylor and Maclaurin theorems with remainders in Cauchy and Lagrange form, power series. Taylor and Maclaurin series, L Hopitals rule, extreme values of a function of one variable using first and second derivative test, asymptotes of a function, curvature and radius of curvature of a curve, partial differentiation, exact differential and its application in computing errors, extreme values of a function of two variables with and without constraints. Solution of non-linear equation, using Newton Raphson method.

Integral Calculus

Indefinite integrals and their computational techniques, reduction formulae, definite integrals and their convergence. Beta and Gamma functions and their identities, applications of integration. Centre of pressure and depth of centre of pressure.

Sequence & Series:

Sequence, Infinite Series, Application of convergence tests such as comparison, Root, Ratio, Raabe's and Gauss tests on the behavior of series.

Complex Number

Argand diagram, De Moivre formula, root of polynomial equations, curve and regions in the complex plane, standard functions and their inverses (exponential, circular and Hyperbolic functions).

ME 101 ENGINEERING MECHANICS

Static's of Particles:

Forces in a plane; Newton's First Law, Free body diagram; Forces in space (rectangular components); Equilibrium of a particle in space.

Kinematics of Particles:

Rectilinear and curvilinear motion of particles; Components of velocity and acceleration; Motion relative to a frame in translation.

Kinetics of Particles:

Newton's Second Law; Dynamic equilibrium; Rectilinear and curvilinear motion; Work and energy; Kinetic energy of particle; Principle of Work and Energy; Conservation of energy;

Impulse and momentum; Impulsive forces and conservation of momentum; Impact, direct and oblique; Conservation of angular momentum.

Rigid Bodies:

Equivalent systems of forces; Principle of transmissibility; Moment of a force; Couple; Virginians Theorem. Centre of gravity of a three-dimensional body and centroid of a volume. Moments of inertia, radius of gyration, parallel axis theorem.

Equilibrium of Rigid Bodies:

Free-body diagram; Equilibrium in two and three dimensions; Reaction of supports and connections; Equilibrium of two-force and three-force bodies.

Kinematics of Rigid Bodies:

General Plane motions; Absolute and relative velocity and acceleration.

Plane Motion of Rigid Bodies:

Forces and acceleration; Energy and momentum; Conservation of linear and angular momentum.

Friction:

Laws of dry friction; Angles of friction; Wedges; Square-threaded screws; Journal and thrust bearings; Belt friction.

Analysis of Structures:

Internal forces and Newton's Third Law; Simple and space trusses; Joints and sections; Frames and machines. Forces in cables.

ME 111 ENGINEERING DRAWING

Drawing equipment and the use of instruments; Basic drafting techniques and standards; Geometrical curves including plane curves; Cycloid, Hypocyloid, and the Involute.

Intersections at various positions of geometrical bodies such as prisms, pyramids, cylinders and cones. Development of surfaces of prisms. Pyramids, cylinders and cones.

Freehand sketching of machine and engine components; Locking arrangements; Foundation bolts; Stuffing box; Shaft couplings; Foot-step bearing; Pulleys; Engine connecting rod.

Concept of working drawing of component parts of machines and engines; Size, description, dimensions, and specifications; Limit dimensioning and geometric tolerancing; limits; Fits and tolerances, conventional symbols.

Sectioning of machine and engine components; Orthographic projections and standard practices.

Isometric views with particular reference to piping and ducting.

ME 104 WORKSHOP PRACTICE

Use of carpenter's tools; Exercises in preparing simple joints; Bench-fitting practice; Exercise in marking and fittings; Use of measuring instruments.

Smith's forge; Exercise in bending, upsetting and swage.

Familiarizing the students with the following processes:

Soldering and brazing, Welding, Heat treatment, Moulding and casting.

Simple machine shop processes, such as turning, shaping, milling, and sheet metal work.

ES 105 PAKISTAN STUDIES

An Outline of Emergence of Pakistan:
A brief historical survey of Muslim community in the sub-continent. War of Independent 1857 and Aftermatch. Sir Syed Ahmed Khan, Development of Two Nation Theory. Formation of Muslim League. Lucknow Pact. Khilafat & Non-Cooperation Movement. Political Events from 1924 to 1937. Pakistan Resolution - Struggle for Pakistan from 1940 to 1947. Emergence of Pakistan.

Land of Pakistan:
Geophysical conditions, Territorial situation and its importance, Natural Resources - Mineral and Water.

Constitutional Process:
Early effects to make constitution - Problems and issues. Constitution of 1956 and its abrogation. The constitution of 1962 and its annulment. Constitutional and Political Crisis of 1971; The constitution of 1973. Recent constitutional developments.

Post Independence Development:
Education in Pakistan; Planning & Development in the Field of Education. Development of Science and Technology with special reference to Engineering and Architecture.

Brief survey of Pakistan Economy: Industrial and Agricultural Development. Internal and external trade. Economic planning and prospects.

Cultural Development in Pakistan: Definition, Contents and Contributing factors in culture, Development of Art, Philosophy and literature.

Foreign Policy:
Relations with neighbors, Super powers and the Muslim World.

ES 127 PAKISTAN STUDIES FOR FOREIGNERS

Land of Pakistan:
Land & People –Strategic importance – Important beautiful sights – Natural resources (some portion of economics of Pakistan)

A brief Historical Background:
A brief historical survey of Muslim community in the sub-continent – British rule & its impacts – Indian reaction – Two nation theory Origin and development – Factors leading towards the demand of a separate Muslim state – Creation of Pakistan.

Government & Political Development in Pakistan:
Constitution of Pakistan – A brief outline – Governmental structure Federal and Provincial – Local Government Institutions – Political History a brief account.

Pakistan & the Muslim World:
Relations with the Muslim countries.

Language and Culture:
Origins of Urdu Language - Influence of Arabic & Persian on Urdu Language & Literature - A short history of Urdu literature - Dominant Culture features.

PH 112 APPLIED PHYSICS

Introduction:

Scientific notation and significance figures. Types of errors in experimental measurements. Units in different systems. Graphic techniques (Log, semi,-log and other non linear graphs)

Vectors:

Review of vectors, vector derivatives. Line and surface Integrals. Gradient of a scalar

Mechanics:

The limits of Mechanics. Coordinate systems. Motion under constant acceleration, Newton Laws and their applications. Galilean invariance. Uniform circular motion. Frictional forces. Work and energy. Potential energy. Energy conservation. Energy and our environment. Angular momentum

Electrostatics And Magnetism:

Coulombs law. Electrostatic potential energy of discrete charges. Continuous charge distribution. Gauss's law. Electric field around conductors. Dielectrics. Dual trace oscilloscope with demonstration Magnetic field. Magnetic force on current. Hall effect. Biot-savart Law. Ampere's Law. Fields of rings and coils. Magnetic Dipole.
Diamagnetism, Paramagnetism, and Ferromagnetism Semiconductor Physics:
Energy levels in a semiconductor. Hole concept. Intrinsic and Extrinsic regions. Law of Mass Action. P-N junction.Transistor. Simple circuits

Waves and Oscillations:

Free oscillation of systems with one or more degrees of freedom Solution for Modes. Classical Waves equation. Transverse modes for continuous string. Standing waves. Dispersion relation for waves. LC network and coupled pendulums. Plasma oscillations

Optics and Lasers:

Harmonic traveling waves in one dimension. Near and far fields Two-slit interference. Huygens Principle. Single slit diffraction. Resolving power of optical instruments. Diffraction Grating Lasers. Population inversion. Resonant cavities. Quantum efficiency. He-Ne, Ruby and CO2 lasers. Doppler effect and sonic boom.

Modern Physics:

Inadequacy of classical physics, Planck's explanations of black body radiation Photoelectric effect, Compton effect. Bohr theory of Hydrogen atom, Atomic spectra, Reduce mass, De-Broglie hypothesis Braggs Law, Electron microscope, Uncertainty relations Modern atomic model, Zeeman effect, Atomic nucleus, Mass-energy relation, Binding energy, Nuclear forces and fundamental forces, Exponential decay and half-life. Radioactive equilibrium in a chain, Secular equilibrium, nuclear stability, Radiation detection instruments, Alpha decay, Beta decay, Gamma decay attenuation Neclear radiation hazards and safety, Medical uses of Nuclear Radiation. Fission, Energy release. Nuclear Reactors. Breeder Reactor, Nuclear Fusion

IM 101 COMPUTER APPLICATIONS IN ENGINEERING

Computer Programming Basics:

General terminologies, Computing application software, General and Scientific programming languages, Computer programming methods, Compilation and interpretation.

Programming Environment:

Work space, Files and file management, data types, Display options, Accuracy and Precision, Scripts

Functions and graphs:

Solving and plotting functions: Trigonometry, Complex numbers, Logarithm, Polynomials, Partial function expansion. Vector array, Matrix array, Matrix array, Developing Algorithms and using built-in functions of scientific software packages for solving mathematical problems in Matrix algebra, Calculus and Computational geometry

IM 105 THERMOFLUIDS

Introduction & Basic concepts:

Basic concepts, Energy Conservation, Different Form of Energy

Laws of Thermodynamics:

Laws of Thermodynamics

Properties of pure Substance:

Two phase system, Phase diagram, Steam tables.

Entropy:

Entropy, Carnot cycle (Thermal Efficiency, Cycle work & Heat rate), Stirling Cycle (Thermal Efficiency, Cycle work & Heat rate), Otto Cycle (Thermal Efficiency, Cycle work & Heat rate), Diesel Cycle (Thermal Efficiency, Cycle work & Heat rate)

Heat Transfer:

Fundamental of conduction, convection and radiation heat transfer

Fluid Mechanics:

Basic Concepts, Fluid Pressure, Inter connected Vessels, Force Calculations (walls, flat & curved surface), Stability of a Floating Body, Inviscid and Viscous Flow, Continuity, Eulers's and Bernoulli's equations, laminar and turbulent Flow, Measurements of Pressure and Flow rate, Dimensional Analysis

EE 122 Basic of Electricity and electronics

Fundamentals of Electric Circuits:

Charge, Current Voltage, and Power, Voltage and Current Sources, Ohm's Law;

Voltage and Current Laws:

Nodes, Paths, Loops and Branches, Kirchhoff's Current Law. Kirchhoff's Voltage Law, The single loop Circuits, The single Node-pair Circuits, Series and Parallel connected independent sources, Resistors in Series and Parallel, Voltage and Current Division.

Circuit Analysis Techniques:

Multi-Nodal Analysis, The super Nopdal, Mesh Analysis, the Super Mesh, Linearity and Superposition, Source Transformation, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Delta-Wye Conversion. Capacitor, Inductor, Inductance and Capacitance Combination, The Source-Free RL Circuit, Properties of Exponential Response, the Source- Free RC Circuit.

Introduction Machines:

Induction Motors, Construction, Types, Rotating file theory, Principle of working, slip and its effect on motor current quantities, overexcited and under-excited motor, power factor and power factor control, starting of synchronous motor, parallel operation of alternators and sharing of load, working of alternator on infinite bus bars.

Introduction of Transformer:

Construction , Principle of working, emf equation, Transformation rations, No load working and vector diagram, magnetizing current, Vector diagram on load.

One line Diagram:

Symbols of different components, understanding of one line diagram.

Basic Electronics:

P-N junction, diode and applications Transistor construction, operation and applications Fundamental concepts of Digital Electronics.

EA 111 FUNCTIONAL ENGLISH

Introduction to Functional English

Significance of the course and students diagnostic test.

Vocabulary Development

Practice in vocabulary development, Inferring meaning from context, word formation, idiomatic expression

Listening Skill

Types of listening: active, critical, selective, etc. Problems in listening and coping strategies, Listening skills and sub skills.

Reading Skill and Strategies

Strategies used in reading texts: skimming and scanning, Summarizing, Inference.

Note Taking

Techniques for taking notes from lectures, from books (Lecture), Note taking in different forms paragraphs, points, figures, processes, tables, graphs etc. (Worksheets).

Speaking Skill

Importance of speaking and techniques to effective communication. Types of speaking: persuasive, informative, etc.

Writing Skill

Process of Writing with practice in pre writing strategies, in revising, and in, editing for grammar, Writing well- structured and effective essays, and letters using proper writing mechanics.

IM 203 MANUFACTURING PROCESSES

Sand Casting:

Introduction; Sand casting procedures; Patter making; Material types and construction of patterns; Pattern allowances; Moulding process; Moulding materials; Tools and equipment; Testing of sand; Moulding machines; Core making; Types of cores; Core making machines; Shell moulding; Plaster moulding; Centrifugal casting; Trimming and finishing of castings; Seasoning of castings; Inspection of castings.

Die Casting:

Pressure die casting; Vacuum die casting; Gravity die casting; Die casting machines; Hot chamber and Cold Chamber methods; Die casting alloys; Die design, construction, and material; Die casting.

Welding Processes:

Classification of welding processes; Oxyacetylene welding, oxygen torch cutting, and flame straightening; Arc welding; Shielded arc welding, Gas tungsten arc welding, Gas metal arc welding, Flux-cored arc welding, submerged arc welding, plasma arc welding, stud welding, spot welding, Seam welding, Projection welding; Other welding processes: Forge welding, Roll welding, Friction welding, explosion welding, Thermit welding, Electron beam welding, Laser welding and cutting; Brazing and Soldering.

Fabrication of Plastics:

Casting; Blow moulding; Compression moulding; Transfer moulding; Cold moulding; Injection moulding; Reaction injection moulding; Vacuum forming; Welding of plastics.

Machining Processes and Machine Tools:

Machine tools using single point tools: Description, functions and operation performed on lathe, shaper, Planner, and boring machines; work holding devices.

Machine tools using multiple cutting edge tools: Description, functions, and operations performed on drilling, milling, gear cutting, and broaching machines.

Machine tools using abrasive wheels; description and functions of various types of grinding machines; wheel dressing, and wheel balancing; Honing, lapping, and super finishing operations; thread manufacturing.

Non-traditional machining processes such as EDM, ECM, & ultrasonic machining.

Machining parameters:

Determination of machining time and material removal rate for various machining operations. Cutting tools for manufacturing: Cutting tool material characteristics; Cutting tool materials, tool steels, HSS, Cubic Boron Nitrides; Tool Geometry, Tool life, Tool wear, and machinability; Taylor's Tool life model, sharpening and Reconditioning of cutting tools; Basic concept and design of jigs and fixtures.

IM 208 MATERIALS ENGINEERING

Introduction to Materials Engineering:

Types of materials, sources of materials, material science and engineering crystalline & amorphous materials, application of materials.

Metallic Materials:

Pure metals and alloys, nature and properties of metals and alloys, major properties of metallic materials (chemical, physical, mechanical), single crystal and poly-crystalline metals, crystal defects and the mechanisms of deformation and fracture, plastic flow in poly-crystalline materials, structure- property, relationships, macro & micro examinations, structural aspects of solidification & solid phase transformations in binary systems, ferrous and non-ferrous metals, various heat treatments, TTT- diagram.

Ceramics, Glasses, Rubbers & Refractory Materials:

Compositions, properties, structures of various non-metallic materials, application of ceramics, glasses, rubber & refractory materials, methods of manufacture.

Polymers:

Polymerization, Structural feature of Polymers, Thermoplastic Polymers, Thermo-setting Polymers, Additives, major mechanical properties.

Composites:

Introduction to composite materials; types of composite materials, method of fabrication of composite materials, property averaging, major mechanical properties.

Environmental Degradation:

Metal degradation by atmospheric, aqueous & galvanic corrosion; stress corrosion cracking methods of corrosion prevention, behaviors of metal at elevated temperature – pyrometers oxidation, scaling and creep. Chemical degradation of ceramics & polymers, radiation damage, surface improvement against degradation.

IM 209 MECHANICS OF MATERIALS

Stress-Strain Relations:

Stress, Deformation, strain, elastic stress strain behavior of materials, Poisson's ratio,General stress method, Thermal stress and strain

Statically indeterminate System:

Volume changes, Constrained materials, , superposition method, Virtual work).

Bending Stresses:

Simple bending theory, shear stresses in bending, bending slope and deflection, asymmetrical bending, bending of initially curved bars

Theory of Torsion:

Torsion of thin walled cylinder, Torsion of a solid circular shaft, Hollow shaft, Torsion of rectangular and non circular sections, Helical Springs.

Theory of Columns and Pressure vessels:

Long columns, struts, columns with initial curvature, Stresses and strains In pressure vessels.

MT 252 INTRODUCTION TO PROBABILITY & STATISTICS

Statistics:

Introduction, Types of data & variables, Presentation to data, Tabulation, Frequency distribution, Graphical representation, Simple & multiple bar diagrams, Pie-diagram, Histogram, Frequency polygon, Frequency curves & their types, Measures of central tendency and dispersion: Statistical averages, Median, Mode, Percentiles, Quartiles, Range, moments, Skewness & kurtosis, Quartile deviation, Mean deviation, Standard deviation, Variance & its coefficient, Practical significance in related problems.

Probability:

Basic concepts, permutation & combination, definitions of probability, laws of probability, conditional probability, Bayes' rule, related problems in practical significance.

Random Variable:

Introduction, Discrete & continuous random variables, Random sequences and transformations, Probability mass function, Probability density function, Distribution function, Mathematical expectations, Moment generating function (M.G.F.).

Probability Distributions:

Introduction, Discrete probability distributions: Binomial, Poisson, Hyper geometric & Negative binomial distributions, Continuous probability distribution: Uniform, Exponential, Gamma & Normal distributions & their practical significance.

ES 205 ISLAMIC STUDIES

Themetic Study of Holy Quran.

1. ***Basic Islamic Believes***

Topics
i) *Tauheed:*
Al-Ambiya-22, Al-Baqarah-163-164
ii) *Prophethood:*
Al-Imran-79, Al-Huda-7 Al-Maidah-3
iii) *Here-After:*
Al-Hajj-5, Al-Baqarah-48
*Two Hadith

2. *Basic Islamic Practices:*
Al-Mu'minun-l-ll

3. *Amre-Bil-Ma'Roof Wa-Nahi Anil Munkar*
The Concept of Good & Evil.
i) Importance & necessity of Da'Wat-e-Deen Al-Imran-llO.
ii) Method of Da'Wat-e-Deen. An-Nehl-125, Al-Imran-l04
*Two Hadith

4. *Unity of the Ummah:*
Al-Imran-l03, Al-Hujurat-l0, Al-Imran-64, AI-An'am-l08
*Two Hadith

5. *Kasb-e-Halal.*
Taha-8l, Al-A'raf-32-33, Al-Baqarah-188
*Two Hadith.

6. *Huquq-ul-Ibad:*
i) *Protcetion of Life*
AI-Maidah-32

ii) *Right to Property*
An-Nisa-29

iii) *Right of Respect & Dignity*
AI-Hujurat-11-12

iv) *Freedom of Expression*
AI-Baqarah-256

v) *Right of Equality*
AI-Hujurat-13

vi) *Economic Security*
AI-Ma'arij-24-25

vii) *Exployment Opportunity on Merit*
An-Nisa-58

viii) *Excession Right to Justics*
An-Nisa-135

7 .*Women Rights:*
An-Nehl-97, AI-Ahzab-35, An-Nisa-O7

8. *Relations With Non-Muslims:*
AI-Mumtahanah-8-9, AI-Anfal-61.
Last sermon of Hajj at Arafat, Translation & the important points of the sermon.

Serat Life of the Holv Prophet:
Birth, Life at Makkah.Declaration of Prophethood, preaching & its difficulties migration to Madina. Brotherhood (Mawakhat) & Madina charter. The Holy War of the prophet (Ghazwat-e-Nabawi) Hujjat-ul- Wida.

Islamic Civilization:
Impacts of Islamic civilization on the sub-continent. The civilization of sub- continent before Islam. The Political, Social & Moral impacts of Islamic Civilization on sub-continent.
Academic, Intellectual, Social & Cultural Impacts of Islam on the World.

ES 209 ETHICAL BEHAVIOUR

1. Introduction to Ethics:
i) Definition of Ethics
ii) Definition between normative and positive science
iii) Problem of freewill
iv) Methods of Ethics
v) Uses of Ethics

2. Ethical Theories:
i) History of Ethics: Greek Ethics, Medieval, Modern Ethics
ii) Basic Concepts of right & wrong: good & evil
iii) Utilitarianism, hedonism, self-realization: egoism, intuitionism, rationalism
iv) Kant's moral philosophy

3. Ethics & Religion:
i) The relation of Ethics to religion
ii) Basic ethical principles of major religions: Hinduism, Judaism, Buddhism, Zoroastrianism, Christianity, Islam

4. Ethics, Society and Moral Theory:
- Society as the background of moral life
- Ethical foundation of rights of moral life
- Universalism and Altruism
- Applied Ethics
- Theories of punishment

IM 211 MACHINE DESIGN

Principle of Design:

General procedure for design, Mechanical properties of materials,
Stresses in machine elements, Stress concentration, Composite sections, Theories of failure including fatigue failure.

Design of Machine elements:

Shafts, Shaft materials, Shaft operating under combined loading, Critical speed, Introduction to flexible shafting, connecting rods, Crankshafts, Bearings, Bearing materials, Design of journal and roller bearing, Theory, and method of lubrication, Gyroscopes (principle, operation, and applications), Balancing of reciprocating and Rotating masses.

Design of Drive Units and Assemblies:

Gear (terminologies, classification and design), Design of gear boxes/trains, Belt and chain drives, Design of chain including drag chain conveyors and belt conveyors, Brakes, Clutches; Friction and mechanical type of clutches, Linkages, Cams, Joint (knuckle, Cotter and universal), Couplings (universal, flanged and flexible). Spring, Design of leaf springs.

IM 212 COMPUTER AIDED ENGINEERING DESIGN

Introduction to CAD:

CAD applications in Engineering, Mechanical product design, CAD, CAM and CAE integration, Components of CAD.

Graphic Programming:

Concepts of Graphics Programming, Coordinate transformations, Projections.

Geometric Modeling Systems:

Modeling Methods, set operations Constructed solid geometry, Boundary representation.

Curves and Surfaces:

Representation of Curves & Surface Types of representations, Analytic, manipulation of curves and surfaces

Data Exchanges:

CAD/CAM Data Exchange Data types and exchange methods, Neutral data exchange format: IGES, STEP

Applications of CAD:

Reverse Engineering & Rapid Prototyping/Manufacturing3D scanning and its types, Surface fitting on cloud data rapid prototyping and manufacturing

IM 213 METROLOGY AND QUALITY CONTROL

Metrology:

Introduction, History and Philosophy of Metrology, Metrology and the need for Reliable Measurement. Metrology Classifications

Standardization:

Standardization Organizations and their Standards related to metrology, International Classification for metrology Standards, Interchangeability.
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Measurements:

Common Gauges & Measurement Instruments, Special Gauges and application, Gauge Selection and handling and use, Surface Plate Tools and Techniques, Specialized Inspection Equipment, Calibration. Surface Texture.

Measurement System Analysis:

Process Variability, Variability in Measurement Process, Evaluating Measurement System Performance. Inspection Planning & processes, defining SPC/SQC and its Tools/ Techniques

Quality control

Introduction, Statistical Methods in Metrology, Defining Quality & its Philosophies, defining SPC/SQC and its Tools/Techniques.

Quality Control Tools:

Flow Chart, Check Sheet, Histogram, Pareto Chart, Scatter Diagram, Cause and Effect Diagram, Variable & Attribute Control Charts.

Acceptance Sampling:

OC Curve, Consumer & Producer Risks, AQL & LTPD, Sampling Errors, Acceptance Sampling for Continuous Production, Acceptance by Variables, Single, Double, & Sequential Sampling.

Process Capability:

Cp/Cpk

Reliability:

Introduction, Life History Curve, Taguchi Loss Function.

MF 303 Applied Economics for Engineers

Introduction
Engineering economy defined; Measures of financial effectiveness; Non-monetary factors and multiple objectives; principles of engineering economy.

The Economic Environment
Consumer and producer goods; Measures of economic worth; Price, Supply, & Demand relationship; Production; Factors of production; Laws of return.

Cost Concepts & Analysis
Sunk & opportunity costs; Fixed, variable, and incremental costs; Recurring & nonrecurring

costs; Direct, indirect, and overhead costs; Standard costs; Breakeven analysis; Unit cost of production; Cost-benefit analysis; Feasibility studies; Value analysis in designing & purchasing.

Time Value of Money

Simple interest, Compound Interest, Cash flow diagrams, Interest formulas, Nominal versus effective interest rates, continuous compounding.

Depreciation and Depletion

Purpose of depreciation, types of depreciation, economic life, what can be depreciated?

Comparing Alternatives

Present economy, Selection among machines, materials, processes, and designs, Payback period method, Present worth method, Uniform annual cost method, Rate of return method, Alternatives having identical live, Alternatives having different lives.

Production Concepts & Mathematical Models

Manufacturing lead time; Production rate; Capacity; Utilization; Availability; Work in process; WIP and TIP ratios.

Linear Programming

Mathematical statement of linear programming problems; Graphic solution; Simplex method; Duality problems.

Capital Financing and Budgeting

Types of ownership; types of stock; Partnership & joint stock companies; Banking & specialized credit institutions.

Industrial Relations

Labour problems; Labour organizations; Prevention & settlement of disputes.

MT 225 LINEAR ALGEBRA & ORDINARY DIFFERENTIAL EQUATIONS

Linear Algebra:

Linearity and linear dependence of vectors, basis, dimension of a vector space, field matrix and type of matrices (singular, non- singular, symmetric, non- symmetric, upper, lower, diagonal tri-diagonal matrix), Rank of a matrix using row operations and special method, echelon and reduced echelon forms of a matrix, determination of consistency of a system of linear equation using rank, transitions matrix, basic concept of tensors, eigen value and eigen vectors of a matrix, Diagonolization, Cayley-Hamiton theorem. Applications of linear algebra in Engineering.

Euclidean Spaces and Transformation:

Geometric representation of vector, norm of vector, Euclidean inner product, projections and orthogonal projections, Euclidean n spaces n properties Cauchy-Schwarz inequality, Euclidean transformations, apply geometric transformations to plane figure, composition of transformations.

1st Order Differential Equations:

Basic concept; Formation of differential equations and solution of differential equations by direct integration and by separating the variables; Homogeneous equations and equations reducible to homogeneous from; Linear differential equations of the order and equations reducible to the linear form; Bernoulli's equations and orthogonal trajectories; Application in relevant Engineering.

2nd and Higher Orders Equations:

Special types of IInd order differential equations with constant coefficients and their solutions; The operator D; Inverse operator 1/D; Solution of differential by operator D methods; Special cases, Cauchy's differential equations; Simultaneous differential equations; simple application of differential equations in relevant Engineering.

Lap lace Integral & Transformation:

Definition, Laplace transforms of some elementary functions, first translation or shifting theorem, second translation or shifting theorem, change of scale property, Laplace transform of the nth order derivative, initial and final value theorem Laplace transform of integrals, Laplace transform of functions t^n F(t) and F(t)/ t, Laplace transform of periodic function, evaluation of integrals, definition of inverse Laplace transform and inverse transforms, convolution theorem, solutions of ordinary differential using Laplace transform.

IM 303 PRODUCTION MANAGEMENT

Production Management & Systems:

Introduction to production Management; System concept; Functions of management; Managerial decision making; Models as decision aids.

Plant Location & Plant Layout:

Selection of region; Selection of community; Site selection; Location factor dependence; Sources of assistance; Plant location trends; Quantitative analysis; Plant layout; Product & process layout analysis and comparison; Material handling considerations in layout.

Production Planning & Control:

Formalized production planning; Production planning methods; Master scheduling; MRP; MRP inputs, MRP outputs; Product structures; Types of MRP; Capacity planning and control; Production control systems; Job shop scheduling; Production control charts; Scheduling techniques; Purchasing and procurement.

Planning & control Techniques:

Inventory control; types of inventory; Inventory costs; Independent versus dependent demand; EOQ/EPQ models; Types of control systems; Selective inventory control; Inventory system development; Project planning; CPM/PERT; Network development; Determination of activity times; Establishment of critical path; Probabilistic statements.

Cost Estimating:

Element of cost; Material cost, direct and indirect labour cost and Over head cost. Cost structure; Prime cost, Factory cost, Manufacturing cost, Total cost, Selling price; Estimation of cost elements; Methods of estimation; Economics of tooling.

Maintenance:

Types of maintenance; Breakdown maintenance; Preventive maintenance; Individual versus group replacement; Internal versus external maintenance.

IM 310 TOOL DESIGN

Jigs and Fixtures:

Basic Design principles and Classification. Materials for jig and fixture development. Lathe, Milling and Broaching fixtures. Detailed discussion of jigs for drilling and drilling related operations. Consideration for mounting jigs and fixtures on machine tools. *Inspection Jigs and Fixtures.* Analysis of operation with design examples.

Locating and Clamping Methods:

Principles of Location. Pins, plugs, dowels and nests. Conical Locating, adjustable locators. Clamping principles, design of various clamps with typical applications. Pneumatic and Hydraulic clamping.

Design of Cutting Tools:

Design of tools for cutting operations. Single point tools for lathe and boring operations. Multiple point tools for milling and drilling operations.

Design of Dies and Moulds:

Terminology of Press-Working operations. Mechanical, Hydraulic and Pneumatic presses. Materials for press tools. Design of Piercing, Blanking and Shearing dies. Design of Bending, Forming and Drawing dies. ***Design of Moulds for plastic and Rubber Parts***. Pressure, Die Casting, Injection and Blow moulding.

IM 312 APPLIED THERMOFLUIDS

Flow through pipes:

Revision of continuity momentum and steady flow energy equation, fraction in pipes and fittings, evaluation of friction losses.

Selection of pumps:

The operation of positive displacement pumps, centrifugal pump, including the condition and delivery, Net positive suction Head (NPSH), pump characteristics, Power requirement and pump selection.

Control valves:

Most common valve types, design specification, valve characteristics.

Actuator:

Electric motors (DC, stepper, brushless and AC) servo motors, piezoelectric actuators, hydraulic and pneumatic actuation systems.

Refrigeration cycles:

Reserved Carnot cycle, vapor compression cycle, vapor absorption cycle, multi-pressure systems.

Application of Refrigeration:

Domestic refrigerator, water cooler, cold storage, ice making plant, dairy industries, heat pump, use of commercially available software.

Heat Exchanger:

Introduction to Heat exchanger, Classification and preliminary design of heat exchangers, applications

MT 333 ADVANCED CALCULUS & FOURIER ANALYSIS

Partial Differential Equation:

Basic concepts and formation of partial differential equations; Linear homogeneous partial differential equations and relations to ordinary differential equations; Solution of first order linear and special types of second and higher order differential equations; D' Alembert's solution of the wave equation and two dimensional wave equations; Lagrange's solution; Various standard forms.

Fourier series:

Periodic functions and expansion of periodic functions in Fourier series and Fourier coefficients; Expansion of function with arbitrary periods. Odd and even functions and their Fourier series; Half range expansions of Fourier series, " DFT and FFT, Fourier Spectrum".

Advance calculus:

Define a stationary point of a function of several variables, define local maximum, and saddle point for a function of two variables the stationary points of a several variables, obtain higher partial derivatives of simple functions of two or more variables, iterated integrals, double and triple integrations with applications (area, centoroid, moment of inertia, surface area, and volume, use multiple integrals in solutions of engineering problems.

Vector Calculus:

Vector differential operator, directional derivative, gradient, divergence, curl of a vector field, and Laplacian operators with applications. (Solenoid, conservative, etc). Vector Integrations; Evaluate line integrals along simple paths, apply line integrals to calculate work done, apply Green's theorem in the plane to simple examples, evaluate surface integrals over simple surface, use the Jacobian to transform a problem a new co-ordinate system, apply Gauss' divergence theorem to simple problems, apply Stokes' theorem to simple examples.

EA 304 BUSINESS COMMUNICATION & ETHICS

Communication Skills (oral):

Definitions and Conditions, Modes: verbal, non-verbal, vocal, non-vocal, sender, Receiver, encoding, decoding, noise, context, emotional maturity, relationships, etc. Language, perception, Non-verbal, body language, physical appearance, cultural differences etc. Personal and interpersonal skills / perceptions, Communication dilemmas and problems; Public Speaking – speaking situation, persuasion, Making presentations, Interviews

Business Writing:

Formal / Business letters, e-mails: a) job applications and resumes/ cv, b) enquiries, c) complaints / adjustments, d) orders, e) quotations, f) banking etc. Memos: layout, language, style Meeting management: notice, agenda, conducting / participating, writing minutes. Contracts and agreements (basic theoretical knowledge and comprehension), Research / scientific reports : types, structure, layout / presentation, writing process etc. Tenders (basic theoretical knowledge and comprehension)

Engineering / Business Ethics:

Need and objectives for code of ethics and its importance, Type of ethics, involvement and impact in daily life. Problems / conflicts / dilemmas in application. Review of Pakistan Engineering Council Code of Conduct.

IM 307 ADVANCE MANUFACTURING PROCESSES

Mechanics of Orthogonal Metal Cutting:

Chip formation; Thin-zone models for analysis; Shear angle relationships; Role of friction in metal cutting; Prediction of forces; Velocity relationships; Force and stress relationships.

Tool Life & Tool Wear:

Forms of wear in metal cutting, Tool life criteria, Variables affecting tool life, Taylor's tool life equation, Generalized tool life equation, Methods of tool life testing data. Economics of Metal Cutting: Application of minimum cost per piece, maximum production rate, and maximum profit rate criteria in turning operations.

Metal Forming:

Stress: stress tensor, equilibrium equations, stress transformation equations, plane stress, Mohr's circle for stress transformation. Strain: plane strain, strain tensor, strain transformation equations, isotropic elasticity, strain energy. Bulk forming, sheet forming, Yield criteria, Plastic work, Plastic instability, Effective stress, Effective strain, Flow rules for plastic stress-strain relations.

Work Hardening:

Tensile test, Mechanical properties, Nominal & true stress-strain curves, Work hardening expression, Behavior after necking, Direct compression, Bulge test, Plane-strain compression test.

Bulk Forming Analysis:

Ideal work method, efficiency factors, extrusion and rod drawing, force balance or slab analysis, deformation zone geometry, sheet drawing, flat rolling, direct compression in plane strain, sheet bending, formability.

Hot & Cold Working of Metals:

Advantages and limitations of Hot working and Cold working processes; Methods of Forging; Hammer forging; Die forging; Drop, Press and Upset forging; Construction of drop forging hammers; Forging defects and their causes.

IM 308 OPERATIONS RESEARCH

Linear Programming:

Historical development of Operations Research, Formulation of Model, Linear programming: Graphical Analysis and Solution, Simplex Method of Solution, Equality constraints, Inequality constraints, Big M method, Duality theory, Primal and Dual problems, & Sensitivity Analysis.

Special Types of LP Problems:
The transportation problem, North-west corner rule, Vogel's approximation method, Russell's method, Transshipment problem, Assignment problem.

Queuing Theory:

Basic Queuing process, Assumptions for analysis, Queuing discipline and characteristics, Service mechanism, The birth and death process, Steady-state measures of performance, Single-server models, Multiple-server models, Machine servicing model.

Dynamic programming:

Recursive nature of computations in DP, Forward and backward recursion, Selected DP applications.

Simulation:

Introduction to simulation and its application in manufacturing.

*IM 320 MODELING & SIMULATION

Introduction:

Modelling & Simulation – Need and Significance of Simulation; Computer Simulation; Randomness in Simulation; Types of Simulation; Simulation Process.

Spreadsheet Simulation:

Simulation in a Spreadsheet Environment; Useful Spreadsheet Functions; Numerical Examples of Spreadsheet Simulation.

Simulation Using Software:

The Software Environment, Simple Monte Carlo Simulation.

Modelling Simple Discrete Event Dynamic System (DEDS):

Drive-Through Pharmacy; Implementation of Model in Software Environment; Introduction to Arrival Process; Resources; Processes; Defining Run Parameters; Analysing results.

Modelling Queuing & Inventory System:

Introduction, Single Line Queuing System, Simulating Single Queues in the Software, Networks of Queueing Station – Station, Route and Sequence Modules in the Software, Modelling and (Q, R) Inventory Control Policy.

IM 408 AUTOMATION & ROBOTICS

Production Operations & Automation Strategies:

Automation defined; Types of automation; Reasons for automation; Arguments for & against automation. Manufacturing industries; Types of production; Functions in manufacturing; Organization & information processing in manufacturing; Plant layout; Production concepts & mathematical models; *CIM, FMS/FMC,* Automation strategies.

Automotive Type Automation

Automated flow lines; Methods of work-part transport; Transfer mechanism; Buffer storage; Control functions; Automation for machining operations; Design & fabrication considerations.

Analysis of Automated Flow Lines & Line Balancing:

General terminology & analysis, Analysis of transfer lines without storage, Partial automation. The assembly process, Assembly systems, Manual assembly lines, The line balancing problem; Methods of line balancing: Largest candidate rule, Kilbridge & Wester's method, Ranked positional weights method.

Automatic Control Systems and Components:

Basic elements of automatic control system, Levels of automation, Analysis of regulated and servo control systems, Sensors, Actuators, Data conversion, Mechanical components of automation.

Robotics Technology & Applications

Robot anatomy, Robot Configurations, Accuracy & Repeatability, Robot specifications, End effectors, *Kinematics and Dynamics of a 2-link Manipulator,* Characteristics of Robot applications, Robot cell design, Types of Robot applications.

IM 411 METHODS ENGINEERING

Work Study:

Definition; Objectives; Procedure; Process chart symbols; Outline process chart; Flow process charts; Multiple activity chart; Two handed chart; Critical Examination; Case studies & Application.

Method Study:

Introduction to work study, Techniques of work study and their relationship, Basic procedure of work study.

Work Measurement:

Definition; Objectives; Techniques of work measurement; Stop watch time study; Timing methods; Performance rating; Standard timing; Allowance factors. Work sampling; Confidence level; Determination of sample size; Making random observations; Scope of work sampling. Predetermined time standards; Definition; Advantages and criticisms; Motion classification; TMU; Use of PTS systems. Introduction to project management.

Methods and movements at the workplace:

General considerations, the principles of motion economy, Classification of movements, Re-organization of a workplace by means of a two-handed process chart, Micro-motion study, Simo chart, Use of films in methods analysis, The development of improved methods.

Ergonomics:

Human and working environment Interaction, lighting, illumination design, noise and vibration, temperature, dust, humidity, comfort level. Machine controls and displays of dials, Scope of Ergonomics and its practice in Pakistan.

IM 402 COMPUTER AIDED MANUFACTURING (CAM)

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.

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.

MG 450 PRINCIPLES OF SUPPLY CHAIN MANAGEMENT

Introduction to Supply Chain:

Introduction to logistic & supply chain management, Internal and external supply chain, Operational issues.

Value of Information:

Value for Information, Information Technology in Supply Chain.

Modeling of Supply Chain:

Supply Chain Modeling, Coordinate Product and Supply Chain Management.

Decision Making:

Decision Support System for Supply Chain, Customer Value, International Supply Chain Management, and Inventory Management.

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

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.

Hazards 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 worker 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.

MG- 481 Entrepreneurship

Understanding the Entrepreneurship Mind-set:

- The revolution impact of Entrepreneurship
- The individual Entrepreneurship Mind-set
- Corporate Entrepreneurship Mind-set
- The Social and Ethical perspectives of Entrepreneurship

Launching Entrepreneurship Ventures:

- Creativity and innovations
- Methods to initiate ventures
- Legal challenges in Entrepreneurship
- The search for Entrepreneurship

Capital Formulation of Entrepreneurship Plan:

- The assessment of function with opportunities
- The marketing aspects of new ventures
- Financial statements in new ventures
- Business plan preparation for new ventures

Strategic Perspectives in Entrepreneurship:

- Strategies growth in Entrepreneurship
- Valuation challenges in Entrepreneurship
- Final harvest of a new venture

Teaching Methodology:

Lectures: Interspersed with interactive sessions in class Practical work: Spoken language, pronunciation, accent reduction, discussion etc.

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 PROJECTS

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.

*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 Techniques:

Monitoring of vibration, Wear-Debri 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 Scheduling:

Listing Activities, Developing a Network, Types of Network Diagrams, Duration Estimation, CPM/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, Bottom-Up Budgeting, Activity-Based Costing.

Project Execution, Monitoring and Closing:

Project Execution Process, Issues during Project Monitoring, Project Control, Project Closing Process, Lessons Learned.

IM – 420 Basics of Additive Manufacturing

Introduction

Terms and definitions, historical evolution of AM, comparison of AM and traditional manufacturing processes, benefits, limitations and applications of AM.

Development of AM Technologies

Computers, Computer Aided Design (CAD), other associated technologies, steps of AM, types of AM processes.

Vat Photopolymerization Processes

Process description, machines, materials, applications, benefits and drawbacks.

Powder Bed Fusion Processes

Process description, machines, materials, applications, benefits and drawbacks.

Binder Jetting Processes

Process description, machines, materials, applications, benefits and drawbacks.

Material Extrusion Processes

Process description, machines, materials, applications, benefits and drawbacks.

Vacuum Casting

Process description, machines, materials, applications, benefits and drawbacks.

Design for Additive Manufacturing

Design for Manufacturing and Assembly, Unique Capabilities of AM, Exploring Design Freedoms, CAD tools for AM, Open-source and low cost AM processes.

IM – 421 Smart Manufacturing Systems

Introduction of Smart Manufacturing:

Emerging trends in manufacturing, globalization, advanced technologies in manufacturing, fourth industrial Revolution, Smart Factories.

Internet of Things (IoT):

Basics of IoT, Industrial Internet of things (IIoT), Industrial actuators, Industrial internet systems, Smart Devices

Augmented/Virtual Reality and Simulation:

Introduction to virtual and augmented reality, applications, transformation of 3D models in virtual reality, hardware and software used for virtual and augmented reality.

Artificial Intelligence (AI) and Cloud Computing:

Data analytics, basic algorithms used in AI, Applications in manufacturing/inventory management/ machining etc. Machine Learning, Application Software, Data Center Networks, Data Security, Cloud Computing platforms, MS-Azure and Cloud Security.

Cyber-Physical System (CPS):

Framework of smart factories, integrated smart systems, components of CPS, data analytics

IM – 422 Ergonomics in Workplace Design

Introduction of Ergonomics:

Ergonomics, Ergonomist, social value of Ergonomics, General and Individual Ergonomics

Postures and Movement:

Biomechanical, Physiological, Anthropometric Background. **Postures:** Sitting, Standing Change of Posture, Hand and Arm Postures.

Movement:

Lifting, Carrying, Pulling and Pushing.

Information and Operation:

The user, **Information:** Visual, Hearing and Other senses. **Controls for Operation:** Fixed, Wireless, Remote and Hands-Free Controls.

Environmental Factors:

Noise, Noise Reduction at Source, Noise Reduction through Workplace Design and Work Organization, Hearing Conservation, Vibration, Preventing Vibration, Illumination, Light Intensity, Guidelines on Brightness Differences, Guidelines for the Colour of the Light, Guidelines for Improving Lighting, Thermal Comfort, Heat and Cold, Climate Control.

Anatomical position, reference planes:

Flexion, Extension, Pronation, Supination, Abduction, adduction, Reference Planes

Cumulative Trauma Disorders (CTD):

Musculoskeletal disorders, Back and its problem, Neck and its problem, CTDs in the upper extremities, Risks of CTDs, Prevention of CTDs, Treatment of CTDs

Workstation Design: Workplace and Work space, principles of workstation design, Ergonomics principles for work space design, Anthropometric data in workplace design, Ergonomics guidelines for seated and standing jobs**,** Work tool design