DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABI OF COURSES

FOR

B.E. (MECHANICAL) DEGREE PROGRAMME

DEPARTMENT OF MECHANICAL EINGINEERING

SYLLABI OF COURSES
FOR
B.E (MECHANICAL) ENGINEERING PROGRAMME

BATCH: 2012-2013

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY, KARACHI-75270, PAKISTAN

COURSE TITLES FOR B.E MECHANICAL ENGINEERING PROGRAMME

FIRST YEAR

SPRING SEMESTER					FALL SEMESTER				
Course Code	Course Title	Credit Hrs.		Total	Course Code	Course Title	Credit Hrs.		Total
		Th.	Pr.				Th.	Pr.	
CY-105	Applied Chemistry	3	1	4	PH-121	Applied Physics	3	1	4
MT-111	Calculus	3	0	3	HS-101	English	3	0	3
CE-103	Engineering Surveying-I	3	1	4	EE-101	Basic Electricity and Electronics	3	1	4
ME-102	Engineering Drawing	3	1	4	ME-103	Thermodynamics	3	1	4
HS-105/ HS-127	Pakistan Studies OR Pakistan Studies (for Foreigners)	2	0	2	ME-104	Workshop Practice	0	2	2
					ME-106	Statics	2	1	3

SECOND YEAR

SPRING SEMESTER					FALL SEMESTER				
Course Code	Course Title	Credit Hrs.		Total	Course Code	Course Title	Credit Hrs.		Total
		Th.	Pr.				Th.	Pr.	
EL-232	Electronics	3	1	4	MT-223	Ordinary Differential Equations & Fourier Series	3	0	3
ME-201	Internal Combustion Engines	3	1	4	ME-202	Solid Mechanics-I	3	1	4
ME-203	Production Engineering-I	3	1	4	ME-204	Fluid Mechanics-I	3	1	4
ME-207	Computer Programming & Graphics	2	1	3	ME-205	Elements of Machine Dynamics & Design	3	1	4
ME-213	Dynamics	2	1	3	ME-209	Materials & Metallurgy	3	1	4
HS-205/ HS-209	Islamic Studies OR Ethical Behaviour	2	0	2					

THIRD YEAR

| SPRING SEMESTER | | | | | FALL SEMESTER | | | | |
Course Code	Course Title	Credit Hrs. Th.	Credit Hrs. Pr.	Total	Course Code	Course Title	Credit Hrs. Th.	Credit Hrs. Pr.	Total
HS-304	Business Communication & Ethics	3	0	3	MT-332	Advanced Calculus & Linear Algebra	3	0	3
MT-330	Applied Probability & Statistics	2	1	3	EE-373	Machine Control System	3	1	4
ME-302	Solid Mechanics-II	3	1	4	MF-303	Applied Economics for Engineers	3	0	3
ME-306	Mechanical Vibrations	3	1	4	ME-303	Steam Generation & Steam Turbines	3	1	4
ME-307	Production Engineering-II	3	1	4	ME-304	Fluid Mechanics-II	3	1	4
					ME-305	Machine Design	3	1	4

FINAL YEAR

| SPRING SEMESTER | | | | | FALL SEMESTER | | | | |
Course Code	Course Title	Credit Hrs. Th.	Credit Hrs. Pr.	Total	Course Code	Course Title	Credit Hrs. Th.	Credit Hrs. Pr.	Total
ME-403	Refrigeration & Air Conditioning	3	1	4	MT-441	Advanced Mathematical Techniques	3	0	3
ME-406	Heat Transfer	3	1	4	ME-402	Gas Turbines	3	1	4
ME-415	Operations Management	3	1	4	ME-405	Gas Dynamics	3	1	4
ME-###	Elective Course 1	3	1	4	ME-###	Elective Course 3	3	1	4
ME-###	Elective Course 2	3	1	4	ME-409	Mechanical Engineering Project	0	6	6
ME-409	*Mechanical Engineering Project	-	-	-					

Elective Courses
ME 401 Stress Analysis
ME 404 Nuclear Power
ME 410 Computer Aided Design / Computer Aided Manufacturing
ME 412 Clear Energy Technology
ME 413 Finite Element Analysis
ME 416 Plant Maintenance

*Duration one academic year: Requires literature survey and preliminary work during this semester

FIRST YEAR

SPRING SEMESTER

CY-105   APPLIED CHEMISTRY

Gases

Gas laws, Kinetic gas equation, Vander Waal's Equation, critical phenomenon, Liquidfication of gases, Specific heat (molar heat capacity).

Properties of Solutions and Liquids

Surface tension, Viscosity, Osmosis, Osmotic pressure, PH-Buffer Solution, Spectrophotometer, Basic concepts of colloidal chemistry, Classification purification (Dialysis).

Thermochemistry

Chemical thermodynamics, Hess's Law, Heat of reaction, Relation between H and U, measurement of heat of reaction, Bomb calorimeter.

Electrochemistry

Laws of Electrolysis, EMF series, Corrosion: Theories, inhibition and protection.

Water and Sewage

Sources of water, Impurities, hardness, Water softening, Purification of water for potable and industrial purposes, Electrodialysis, Introduction to environmental pollution, Main sources and effects, Sewage treatment.

Fuels

Types of fuels, Classification of fossil fuels.

Metals and Alloys

Properties and general composition of metals and alloys such as Iron, Copper, Aluminum, Chromium and zinc used in engineering field.

Engineering Materials

Inorganic Engineering materials: Cement, Glass, Organic Engineering Materials: Polymers, Rubbers, Plastics and Paints, Semiconductors and Dielectric materials.

Practical

Determination of total alkalinity of a given sample, Determination of total acidity of a given sample, Determination of the amount of ferrous ions in a given sample: Determination of total hardness of a given sample of water, Determination of surface tension of a given sample, Determination of coefficient of a given sample, Determination of chloride ions in a given sample, Determination of bicarbonate and Carbonate ions in a given sample, Determination of turbidity in a given

sample by precipitation, Determination of turbidity in a given a sample by spectrophotometer, Plotting of titration curve and determination of total alkalinity in a given sample, Plotting of titration curve and determination of acidity in a given sample, Plotting a calibration curve and determination of ions present in a given sample.

MT-111   CALCULUS

Set and Functions

Define rational, Irrational and real numbers, Rounding off a numerical value to specified number of decimal places or significant figures, Solving quadratic and rational inequalities in involving modulus with graphical representations, 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.

Propositional Logic

Definition of Proposition, Statement and argument, Logical operators, Simple and compound proposition, various types of connectives, Truth table, Tautology, Contradiction, Contingency and logical equivalence.

Boolean Algebra

Definition, Boolean function, Duality, Some basic theorems and their proofs, Two valued Boolean algebra, Truth functions, Canonical sum of product form, Digital logic Gates and switching circuit designs.

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).

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.

Solid Geometry

Coordinate systems in three dimensions, Direction cosines and ratios, Vector equation of a straight line, plane and sphere, Curve tracing of a function of two and three variables, Surfaces of revolutions, Transformations (Cartesian to polar and cylindrical).

CE-103   ENGINEERING SURVEYING - I

General Principles of Surveying, Determination and plotting of positions, Scales, Errors and degree of accuracy required.

Chain Surveying

Chains and tapes, Optical square and other instruments, Ranging and chaining line errors in chaining. Field book, Plotting chain survey, Obstacle surveying.

Compass surveying

Prismatic and surveyor's compasses, Meridians, Bearings, Declination and local attraction traversing, Adjustment of compass surveying.

Theodolite Surveying

Types of theodolites and their structure handling and care of instruments, Temporary adjustment of Theodolite, Measurement of Bearings and horizontal and vertical angles, Use of theodolite as leveling instrument.

Plane Table Surveying

Plane table and accessories, Adjustment and orientation methods of plane table surveying, Merits and demerits of plane tabling, Contouring with tangent clinometers, Two point and three point problems.
Box sextant structure adjustment and use for measuring angles.

Leveling

General principles of leveling, Optics of surveying, Telescope and their structure, Types of levels, Temporary and permanent adjustment, Methods of leveling, Level books, Reduction of levels and checks.
Leveling for longitudinal section and cross section, Plotting precautions in leveling, Sources of error, Corrections for covalence and refraction.

ME-102   ENGINEERING DRAWING

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

HS-105   PAKISTAN STUDIES

Historical and Ideological Perspective of Pakistan Movement
Two nation theory, Definition: Claim of Muslims of being a separate nation from Hindus, based upon cultural diversity, Significance: Cultural diversity and interests led to the demand of Pakistan – Lahore resolution, Creation of Pakistan, Factors leading to the creation of Pakistan, Quaid-e-Azam and the demand of Pakistan.

Land of Pakistan
Geo-physical conditions, Geo-political and strategic importance of Pakistan,   Natural   resource mineral, water and power.

Constitutional Process

Early efforts to make a constitution (1947-1956) problems and issues, Salient features of the Constitution of 1956 and its **a**brogation, Constitution of 1962 and its abrogation, Constitutional and Political crisis of 1971, Salient features of the Constitution of 1973, constitutional developments since1973 to date with special reference to the amendments to constitutions.

Contemporary issues in Pakistan

A brief survey of Pakistan Economy**,** **a**n overview of current economic situation in Pakistan: problems issues and future prospects, Social Issues, Pakistani Society and Culture-Broad features, Citizenship: national and international, Literacy and education in Pakistan: problems and issues, State of Science and Technology in Pakistan: a comparison with other countries with special reference to the Muslim world, Environmental issues, Environmental pollution and its hazards, causes and solutions, Environmental issues in Pakistan: government policies and measures and suggestions for improvement, Pakistan's role in the preservation of nature through international conventions / treaties.

Pakistan's Foreign Policies

Evolution of Pakistan foreign policy-1947 to date, A brief survey of Relation with Neighbours, Super Powers and the Muslim World.

Human Rights

Conceptual foundations of Human Rights, What are Human Rights? Definition, origins and Significance, Comparative analysis of Islamic and Western Perspective of Human Rights, UN System for protection Human Rights, UN Charter, International Bill of Human Rights – an overview, Implementation mechanism, Other important international treaties and conventions, The convention on the elimination of all forms of discrimination against women (CEDAW), International Convention on the rights of child (CRC), Convention against torture (CAT), Other treaties and convention, Pakistan's response to Human Rights at national and international levels, Constitutional provisions, Pakistan's Obligations to international treaties and documents, Human Rights issues in Pakistan – a critical analysis, Pakistan's stand on violation of Human Rights in the international perspective.

HS-127   PAKISTAN STUDIES (FOR FOREIGNERS)

Contemporary Issues in Pakistan:

A brief survey of Pakistan's Economy

Agricultural and industrial development in Pakistan, Internal and external **t**rade, Economic planning and prospects

Social issues

Literacy and education in Pakistan, State of science and technology with special reference to IT education, Pakistan society and culture.

Environmental issues

Hazards of atmospheric pollution, Other forms of environmental degradation, their causes and solutions, Pakistan's role in preservation of nature through international conventions/efforts.

Foreign Policy

Relations of Pakistan with neighbours, Relations with Super powers, Relations with Muslim world.

Human Rights: Conceptual foundations of Human Rights

What are Human rights? Definition, significance and importance, Comparative analysis of Islamic and western Perspectives of Human rights.

UN System for Protection of Human rights - an over-view

UN Charter, International Bill of Human Rights, Implementation mechanism.

Other important international treaties and conventions

The convention on the elimination of all forms of discrimination against woman, International Convention on the rights of child (CRC), Convention against torture (CAT), Refugee Convention.

Pakistan's response to Human rights at national and international level

Constitutional Provisions, Pakistan's obligations to international treaties and documents, Minority rights in Pakistan, Pakistan's stand on violation of Human rights in the international perspective.

FALL SEMESTER

PH-121   APPLIED PHYSICS

Introduction

Scientific notation and significant figures, Types of errors in experimental measurements, Units in different systems, Graphical techniques (Log, Semi-log and other non-linear graphs)

Vectors

Review of vectors, Vector derivatives, Line and surface integrals, Gradient of 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 fields, Magnetic force on current, Hall effect, Biot-Savart law, Ampere's law, Fields of rings and coils, Magnetic dipole, Diamagnetism, Para-magnetism 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 and more degrees of freedom, Solution for modes, Classical wave 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 CO_2 lasers, Doppler effect and sonic boom.

Modern Physics

Inadequacy of classical physics, Plank'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, Nuclear radiation hazards and safety, Medical uses of Nuclear radiation, Fission, Energy release, Nuclear reactors, Breeder reactor, Nuclear fusion.

HS – 101   ENGLISH

Study Skills
Reading, dictionary, library skills, speed reading, writing outlines, note taking,

Oral communication
Confidence building, class discussions, speeches, verbal interaction

Advanced reading comprehension:
Using texts dealing with science, literature and human rights (as per HEC recommendation.)

Précis writing
Rules of précis writing, practice précis.

Controlled and guided writing
Pre writing (planning, information gathering, preparing to write), writing, search for topic sentences, developing a theme, following up ideas and arguments ,   outline plans etc.

Essay writing
Types of writing – narrative, descriptive, expository, argumentative etc. ,   Using guided writing to organize essays., Including human rights as essay topics (as per HEC recommendation).

Writing short reports
Short background of report and its importance, memo report, brief reports on events seen / experienced like visit to an exhibition etc.

Letter writing
format and layout, formal letters, types of letters – invitations (acceptance and refusals), condolence, thanks, congratulations, to the editor, chairman class advisor, dean, vice chancellor etc.

Applied Grammar
Morphology, types of sentences, sentence analysis, tenses, jumbled sentences, question tags, homonyms and homophones and their use in sentences, punctuation – sentences and paragraphs, use of idioms

EE-101   ELECTRICAL   TECHNOLOGY

Electric and Magnetic Circuits

Electric circuits, Kirchoff's laws, Superposition theorem, Substitution theorem. Thevenin's theorem, Norton's theorem, Rosen's theorem of star / mesh transormation, Proof for DC circuits and their application to circuit analysis, Magnetic circuit, Series and parallel circuits, Principles of calculation of ampere turns for magnetic circuits of electromagnets, Transformers, Bipolar and multipolar DC machines Inductances in series and parallel, Hysteretis loss , Eddy current loss, Lifting power of magnet.

AC Single phase and Polyphase Systems

Single-Phase systems, Series, Parallel and series parallel circuits, J operator method and polar method. Resonance and measurement of power and power factor, Polyphase systems, Polyphase generation, Star and delta connections, Voltage and current relations, Measurement of power and power factor, Balanced and unbalanced load analysis.

DC Machines

Construction: Simple lap and wave windings, Equalizing connections and dummy coils, Elementary concept of armature reaction and commutation, Cross and demagnetizing ampere turns, DC generator, Types, EMF equation, Losses, Efficiency, Performance curves, Characteristics, Critical resistance and speed and effect of armature reaction of OCC, Internal and external characteristics from OCC neglecting and accounting armature reaction, Calculation of series ampere turns for level and over compounding. Motors, Principle, Back EMF, Torque, Speed and speed regulation, Types, Characteristics, Performance curves, Losses and efficiency, Speed and torque problems involving magnetization curve, Charging and ignition circuits of automobiles.

AC Synchronous Machine

Construction: Stator single layer, Double layer and concentric windings, Damping windings, Coil span factor, Distribution factor, Leakage and armature reaction, Synchronous impedance, Alternators, Types, EMF equation, Speed and frequency, Losses and efficiency, Alternator on load voltage regulation by synchronous impedance method, Synchronous Motors, Types, Principle of working, Vector diagram on load and its analysis for stator current, Power factor, Torque and mechanical output, Effect of variation of excitation, Losses and efficiency.

AC Induction Machines

Induction Motors, Construction, Types, Rotating field theory, Principle of working, Slip and its effect on motor current quantities, Losses, efficiency and performance curves, Starting, Full load and maximum torque relations, Torque slip characteristics.

Transformers

Construction: Principle of working, EMF equation, Transformation ratios, No load working and vector diagram, Magnetizing current, Vector diagram on load, Equivalent circuit, Open circuit and short circuit tests , Losses, Efficiency and performance curves, All day efficiency, Percentage and per unit R,X and Z Voltage regulation and Kapp's regulation diagram, Transformer as a mutually inductive circuit.

Converting Machines

Rotary converters: Construction, Principle of working, Transformer connections, Voltage and current ratios of single and three phase converters, Mercury arc rectifiers, Construction, Operation, Transformer connections, Voltage and current ratios of single phase and three phase rectifiers.

ME-103   THERMODYNAMICS

Thermodynamic Properties

Introduction, Working substance, System, Pure substance, PVT surface, Phases, Properties and state, Units, Zeroth law, Processes and cycles, Conservation of mass.

Energy and its conservation

Relation of mass and energy, Different forms of energy, Internal energy and enthalpy, Work, Generalized work equation, Flow and non flow processes, Closed systems, First law of Thermodynamics, Open systems and steady flow, Energy equation for steady flow, System boundaries, Perpetual motion of the first kind.

Energy and property relations

Thermodynamic equilibrium, Reversibility, Specific heats and their relationship, Entropy, Second law of Thermodynamic property relation from energy equation, Frictional energy.

Ideal Gas

Gas laws, Specific heats of an ideal gas, Dalton's law of partial pressure, Third law of Thermodynamics, Entropy of an ideal gas, Thermodynamic process.

Thermodynamic Cycles

Cycle work, Thermal efficiency and heat rate, Carnot cycle, Sterling cycle, Reversed and reversible cycles, Most efficient engine.

Consequences of the Second Law

Clausius inequality, Availability and irreversibility, Steady flow system.

Two-Phase Systems:

Two phase system of a pure substance, Changes of phase at constant pressure, Steam tables, Superheated steam, Compressed liquid and vapour curves, Phase diagrams, Phase roles, Processes of vapours, Mollier diagram, Rankine cycle, Boilers and anciliary equipment.

Internal Combustion Engines

Otto cycle, Diesel cycle, Dual combustion cycle, Four stroke and two stroke engines, Types of fuels.

Reciprocating Compressors

Condition for minimum work, Isothermal efficiency, Volumetric efficiency, Multi-stage compression, Energy balance for a two stage machine with intercooler.

ME-104   WORKSHOP PRACTICE

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

Smith's forge, Exercise in bending, Upsetting and swaging.

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.

ME-106   STATICS

Statics of Particles

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

Rigid Bodies

Equivalent systems of forces, Principle of transmissibility, Moment of a force, Couple, Varignon's theorem.

Equilibrium of Rigid Bodies

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

Analysis of structures

Internal forces and Newton's Third Law, Trusses, Simple and space trusses, Methods of joints and sections, Frames and machine analysis.

Forces in Beams and Cables

Shear force and bending moment diagrams, Cables with concentrated and distributed loads.

Friction

Laws of dry friction, Coefficient of friction and angles of friction, Wedges, Square-threaded screws, Journal and thrust bearings, Belt Friction.

Distributed Forces

Centroids and centers of gravity, Areas and lines, Composite plates and wires,
Distributed loads on beams, Forces on submerged surfaces, Center of gravity of a three dimensional body and centroid of a volume.
Second moment of area and moments of inertia, Polar moment of inertia, Radius of gyration, Parallel axis theorem.

Method of Virtual Work

Work of a force, Virtual work, Real machines and mechanical efficiency, Potential energy and equilibrium, stability of equilibrium.

SECOND YEAR

SPRING SEMESTER

EL-232   ELECTRONICS

Conduction in Solids

Introduction, Mechanics of conduction, Mobility, Bohr's model for the elements, Energy level diagrams for solids, Conductors, Intrinsic and extrinsic semiconductors, Electron-hole pairs in an intrinsic semiconductor, Distribution of electron and hole in conduction and valence bands, Recombination and lifetime.

Semiconductors and Diodes

Donor and acceptor impurities, Zero biased, Forward biased and reverse biased junction diodes, Junction diode current equation, Depletion barrier width and junction capacitance, Diffusion capacitance, Zero and Avalanche break down, Hall effect, Fabrication of pn junction, Diodes.

Electron Emission Devices

Types of electron emissions, Thermionic diode, Volt ampere characteristics, Child Langmuin power Law, Gas filled diode, Thermionic triode, Parameters and characteristics, Tetrode, Pentode, and beam power tubes , Parameters and characteristics.

Simple Diode Circuits and Applications

Mathematical and graphical analysis of diode circuits, The ideal and non ideal diodes, Piecewise linear models, Analysis of piecewise linear models of vacuum tube and junction diodes, The half wave rectifier, The inductance filter, The inductance capacitance filter circuits, Zener and gas diode, Voltage regulator circuits, Clamping and DC restorer circuits, Voltage doubler circuits, Clipping and limiting circuits.

Bipolar and Field Effect Transistors

Transistor biasing and thermal stabilization, The operating point, Bias stability, Collector to base bias, Fixed bias, Emitter feedback bias, Stabilization for the self biased circuits, Field effect transistors, Basic principles and theory, Types, FET characteristics, Different configurations-common gate, Common source and common drain, The FET, small signal model, Parameters, Biasing of the FET.

Amplifier Circuits

Introduction "h" parameters, Hybrid model for transistor, Elementary treatment, Low frequency transistor amplifier circuits, Stage cascaded LF.

ME-201   INTERNAL COMBUSTION ENGINES

Basic Engine Types and their Operation

Four-stroke spark ignition engine, Speed and load control in S.I engine, The Four-stroke compression Ignition Engine, Speed and Load Control in C.I engine, The two-stroke cycle, Supercharging, Wankel rotary engine.

Testing

Measurement of engine torque and power, Dynamometer principle, Different types of dynamometers: Measurement of brake and indicated horse power, Mechanical pressure indicators, Use of indicator diagram.

Combustion

Combustion Equations, Heat of Combustion, Higher and lower heating values, Adiabatic flame temperature.

Equilibrium Charts

Idealized cycles and processes, The diesel cycle, The dual cycle, Regenerative cycles, Brayton cycle.

Fuels

The natural fuels, Non-petroleum fuels, Characteristics of S.I and C.I engine fuels, LPG as I.C. engine fuel, Octane and Cetane number, Knock and engine Variable: Autoignition in S.I and C.I engines, Knock and S.I engine, Knock and the C.I engine.

Exhaust Gas Analysis and Air Pollution

Air Pollution and the engine, Air pollution and the fuel, Control of exhaust-Gas constituents.

Fuel Metering- SI Engines

The Engine requirements, The Elementary carburetor, Elements of complete carburetor, Calculation of Air: Fuel ratio, Gasoline injection system.

Fuel Metering-CI Engines

C.I injection systems, C.I engine nozzles.

Engine Characteristics

Heat transfer and the engine valve, Timing diagram.

Lubrication

Engine-Lubrication systems: Engine performance and lubrication, Lubricants of different kinds.

ME-203   PRODUCTION ENGINEERING-I

Sand Casting

Introduction, Sand casting procedures, Pattern 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 cooling.

Metal Forming

Fundamentals, Hot working and cold working, Hot working processes: Rolling, Rolling mills, Open die hammer forging, Die drop forging, Press forging, Upset forging, Roll forging, Near net shape forging, Extrusion, Extrusion methods, Extrusion of hollow shapes, Hot drawing, Hot spinning, Pipe welding, and piercing, Cold working processes, Squeezing, Bending, Shearing, and Drawing processes such as rolling, extrusion, Sizing, Riveting, Coining, Peening, Burnishing, Thread rolling, Angle bending, Roll bending, Roll forming, Seaming, Flanging, Straightening, Shearing, Blanking, Perforating, Notching, Nibbling, Shaving, Trimming, Bar and tube drawing, Wire drawing, Embossing and stretch forming.

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, Power sources for arc welding, Arc cutting, Resistance welding, Heating, pressure, Current control and Power supply, Spot welding, Seam welding, Projection welding, Other welding processes: Forge welding, Roll welding, Friction welding, Explosion welding, Thermic welding, Electron beam welding, Laser welding and cutting, Brazing and Soldering.

Fabrication of Plastics

Casting, Blow molding, Compression molding, Transfer molding, Cold molding, Injection molding, Reaction injection molding, Vacuum forming, Welding of plastics.

ME-207   COMPUTER PROGRAMMING & GRAPHICS

Computer Classification

Analogue computer, Hybrid computer, Mainframe, Minicomputer, Microcomputer (Personal Computer), Workstation, Super Computer.

Basic Units of Computer

The system central unit, Processing capability, Word handling capability, Memory, Display, Keyboard,

Operation Systems:

With GUI, Without GUI, UNIX, Concepts of LAN and WAN.

Application Programs

Text editor, Presentation, Mathematical modeling, Simulation, Database, Utilities Programs, Programming, Languages.

Concept of Computer Programming Languages

Variables, Constants, Data types (Char, Word, Integer, Floating), Assignments, Expressions, Operator and precedence, Looping, Pointers, Functions or procedures, Recursion, Back tracking, Program Heading and Declaration part, Modules main module, Language constructs (taking examples of C. Pascal or prolog), Structured programming, Software specification, Software design, Software coding, Software testing.

ME-213   DYNAMICS

Kinematics of Particles

Rectilinear and curvilinear motion of particles, Rectangular, Tangential, Normal, Radial and transverse components of velocity and acceleration, Motion relative to a frame in translation.

Kinetics of Particles

Force, Mass and acceleration, Newton's second law, Dynamic equilibrium, Rectilinear and curvilinear motion, Work and energy, Kinetic energy of a particle, Principle of work and energy, Conservation of energy, Impulse and momentum, Impulsive forces and conservation of momentum, Impact, direct and oblique, Angular momentum of particle and a system of particles, Conservation of angular momentum, Variable systems of particles, Systems gaining or losing mass.

Kinematics of Rigid Bodies

Translation, Rotation about fixed axis, General plane motion, Absolute and relative velocity and acceleration.

Plane Motion of Rigid Bodies

Forces, Acceleration, Energy and momentum, Conservation of linear and angular momentum.

Kinetics of Rigid Bodies in Three Dimensions

Equations of motion of a rigid body about a fixed point, About its mass center or about a fixed axis,
Gyroscopic motion.

HS – 205   ISLAMIC STUDIES

Quranic Verses

Tauheed: Al-Ambiya – 22, Al – Baqarah - 163and164. **Prophet hood:** Al – Imran – 79, Al – Huda – 7, Al- Maidah-3.
Here-After: Al – Baqarah – 48, and one Hadith.

Basic Islamic Practices
Al – Mu' minun-1-11, and two Ahadith
Amer – Bil – Ma ' Roof Wa-Nahi Anil Munkar:, the concept of Good and Evil, Importance and necessity of Da'wat-e-Deen , Al- Imran – 110 Method of Da'wat-e-Deen, An-Nehl-125, Al-Imran-104, and two Ahadith
Unity of the Ummah: Al-Imran-103, Al-Hujurat-10, Al-Imran-64, Al-An' am –108, and two Ahadith .
Kasb-e-Halal: Ta ha-81, Al- A'raf-32-33, Al-Baqarah-188, and two Ahadith.
Haquq-ul-Ibad:, Protection of life, Al-Maidah-32; Right to Property , Al-Nisa-29; Right to Respect and Dignity , Al-Hujurat –11-12; Freedom of Expression, Al-Baqarah-256; Equality, Al-Hujurat-13; Economic Security, Al-Ma' arij – 24-25; Employment Opportunity on Merit, An-Nisa-58; Access to Justice,   An- Nisa-135.
Women's Rights: An-Nehl-97, Al-Ahzab-35, An-Nisa –07;

Relations with Non-Muslims Al- Mumtahanah-8-9,   Al-Anfa'al – 61 and   The last sermon of Hajj of Holy Prophet (PBUH): Relevant extracts.

Seerat (life) of the Holy Prophet (PBUH)
Birth, life at Makkah, declaration of prophet hood, preaching and its difficulties, migration to Madina, brotherhood (Mawakhat) and Madina Charter, The Holy Wars of the Prophet (Ghazwat-e-Nabawi), Hujjat-ul-Wida., The last sermon of Khutbatulwida**:** Translation and important points

Islamic Civilization
In the sub continent: pre- Islamic civilizations. The political, social and moral impacts of Islamic civilization; in the world; academic, intellectual, social and cultural impact of Islam on the world.

HS-206 ETHICAL BEHAVIOUR (Alternate Course for Non Muslim Students)

Ethics – An introduction
Nature, Scope, sources and significance of Ethics, Ethics and Religion, Ethical Teachings of World Religions.

Basic Moral Concepts
Right and Wrong, Good and Evil

An outline of Ethical systems in philosophy
Hedonism, Utilitarianism, Rationalism and Kant , Self Realisation Theories, Intuitionism.

Islamic Moral Theory
Ethics of Quran and its philosophical basis, Ethical precepts from Quran and Hadith and promotion of moral values in society.

FALL SEMESTER

MT-223   ORDINARY DIFFERENTIAL EQUATIONS & FOURIER SERIES

1st Order Differential Equations

Basic concept, Formation of differential equations and solution of differential equations by direct integration and by separating the variables, Homogenous equations and equations reducible to homogeneous form, 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 2nd order differential equations with constant coefficients and their solutions, The D-operator, Inverse operator 1/D, Solution of differential by D-operator methods, Special cases, Cauchy's differential equations, Simultaneous differential equations, Simple application of differential equations in relevant Engineering.

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.

Laplace Integral and 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.

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".

ME-202   SOLID MECHANICS-I

Statically Determinate Frames and Beams
Free body diagrams, Determination of forces in frames, Shear force and bending moment diagrams, Relationship between loading shear force and bending moment.

Statically Determinate Stress Systems
Stress, Direct, Shear Hydrostatic and complementary shear stresses, Bar and strut or column: Thin ring or cylinder rotating, Stresses in thin shells due to pressure or self-weight.

Stress-Strain Relation
Deformation; Strain; Elastic stress-strain behaviour of materials; Lateral strain and Poisson's ratio; Thermal stress and strain; General stress-strain relationships

Statically Indeterminate Stress Systems:
Interaction of different materials, Interaction of different stiffness components, Restraint of thermal strain, Volume changes, Constrained materials.

Bending Stresses
Simple bending theory; General case of bending; Composite Beams; Eccentric end load; Shear stresses in bending

Bending: Slope and Deflection
Deflection curve of the neutral axis; Double integration and Super-position methods.

Theory of Torsion
Torsion of thin-walled cylinder; Torsion of a solid circular shaft; Hollow shafts; Non-uniform and composite shafts, Tapered shaft, Torsion of thin rectangular strip, Torsion in helical springs.

Theory of Columns
Euler's theory of buckling; Eccentric loading of long columns. Behaviour of ideal and real struts. Struts with initial curvature; Crinkling; Members subjected to axial and transverse loading.

ME-204   FLUID MECHANICS-I

Properties of Liquids and Gas

Ideal and real fluids, Properties and gases, Viscosity and compressibility of fluids, Fluid pressure.

Fluid Statics (Equilibrium)

Euler's conditions of equilibrium, Pressure in a fluid under the action of gravity, Homogeneous fluid, Several fluids of different specific weights, Interconnected vessels, Constant-velocity rotation of a liquid around-fixed axis, Fluid under pressure neglecting gravity, hydraulic circuits, Force on container wall, Force on flat surfaces: Force on curved surfaces, Buoyancy of fluid at rest, Stability of a floating body, Surface tension and capillary tubes.

Atmospheric equilibrium, Isothermal state, Adiabatic state, The standard atmosphere.

Fluid Dynamics

One dimensional inviscid flow (flow filament theory), Equation of continuity, Euler's equations of motion, Bernoulli's equation, Impulse and momentum, One dimensional viscous flow, Generalized Bernoulli's equation, Laminar and turbulent flow in circular pipes, Pipe flow problems, Flow in open channels.

Dimensional Analysis

Buckingham- Pi Theorem, Reynolds' Law of Similitude.

Fluid Measurements

Measurement of static pressure, Stagnation pressure, flow velocity and flow rate.

Hydraulic Circuits

ME-205   ELEMENT OF MACHINE DYNAMICS AND DESIGN

Machine Dynamics

Basic definitions; Simple Crank and Cam Mechanisms; Gyroscopic motion, Theory of steering gears; Turning – moment diagrams; Belt and Chain drives; Clutches, Brakes and Dynamometers; Balancing of rotating and reciprocating masses.
Governors, types of governors, Governor effort and power, controlling force and governor stability.

Principles of Design

Mechanical Properties of Materials; Elasticity; Plasticity; Resilience and toughness; Endurance limits; Hardness; Ductility and brittleness; Stress concentration, notch sensitivity, Soderberg and Goodman diagrams; Design Parameters and Operating Conditions, Deflection; Torsion; Shear Center; Thermal stresses, Composite sections; Simple Framed Structures, Creep; Fatigue.

Design of Simple Machine Elements

Joints and Fasteners; Knuckle, Cotter, Universal and welded joints; Threaded and riveted fasteners; Couplings: Universal, Flanged, Flexible and Fluid type couplings. Pulleys and Flywheels; Keys and Pins Helical and Leaf type springs. Design of a belt conveyer, Design of chains including drag chain conveyor. Apron feeders, Safety and Reliability in Design

ME-209   MATERIALS AND METALLURGY

Introduction to Materials Engineering

Types of materials, Source of materials and their extraction, Crystalline and amorphous materials, Application and selection of materials (basic criteria for different environments).

Metallic Materials

Pure metals and alloys, Nature and properties of metals and alloys, Major properties of metal and alloys, Single crystal and polycrystalline metals, Crystal defects and the mechanism of deformation and fracture, Plastic flow in polycrystalline materials, Structure property relationship, Macro and micro examination, Structural aspect of solidification and solid phase transformation in binary systems, Ferrous and non ferrous metals, Steel making processes, Heat treatments, TTT diagram, Surface hardening coatings, Powder metallurgy, Non destructive testing.

Ceramics, Glasses and Refractory Materials

Compositions, Properties, Structures of various non metallic materials, Application of ceramics, Glasses, refractory materials, Methods of manufacture

Polymers and Rubbers

Polymerization, Structural feature of polymers, Thermoplastic polymers, Thermo setting polymers, Additives, Major mechanical properties, Rubber (Elastomers), Synthesis of rubber

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 atmosphere, Aqueous and galvanic corrosion, Stress corrosion cracking, Methods of corrosion prevention, Behavior of metal at elevated temperature pyrometer, Oxidation, Scaling and creep, Chemical degradation of ceramic and polymers, Radiation damage of surface, Improvement against degradation.

THIRD YEAR

SPRING SEMESTER

HS-304   BUSINESS COMMUNICATIONS AND 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 and perception, Distortion of thought, interference.
Non-verbal, body language, physical appearance, cultural differences etc.
Barriers to Comm: ambiguity, context, closure, prediction, pseudo listening,
Listening: effective listening, benefits, and ethics for listener.
Personal and interpersonal skills/perceptions.
Communication dilemmas and problems.
Public Speaking – speaking situations, persuasive speeches / interviews

Written Communication

Types of messages and various approaches
Formal / Business letters various types
Memos (brief revision).
Notice and minutes of meetings, agenda, layout, language, Leadership styles.
Contracts and agreements (basic theoretical knowledge and comprehension).
Tenders (basic theoretical knowledge and comprehension).
Participating in seminars, interviews, writing and presenting conference papers, solving IELTS type papers. (Non-examination).
Business reports (Short and Long) Research / scientific reports.

Engineering / Business Ethics

Course objective.
Need for code of ethics, importance
Type of ethics, involvement in daily life, professional ethics
Problems/conflicts/dilemmas in application.
Review of Pakistan Engineering Council Code of Conduct.

MT-330 APPLIED PROBABILITY & STATISTICS

Statistics: Introduction, Types of data & variables, presentation of data, object, classifications, Tabulation, Frequency Distribution, Graphical Representation, Simple & Multiple Bar diagrams, Sartorial & Pie-Diagram, Histogram, Frequency Polygon, Frequency Curves & their types.

Measures of Central Tendency and Dispersion: Statistics Averages, Median, Mode, Quartiles, Range, Moments, Skewness & Kurtosis, Quartile Deviation, Mean Deviation, Standard Deviation, Variance & its coefficient, Practical Significance in related problems.

Curve Fitting: Introduction, fitting of a first and second degree curve, fitting of exponential and logarithmic curves, related problems, Principle of least squares, Second order Statistics & Time series.

Simple Regression & Correlation: Introduction, Scatter diagrams, Correlation & its Coefficient, Regression lines, Rank Correlation & its Coefficient, Probable Error (P.E), Related problems.

Sampling and Sampling Distributions: Introduction, Population, Parameter & Statistics, Objects of sampling, Sampling distribution of Mean, Standard errors, Sampling & Non-Sampling Errors, Random Sampling, Sampling with & without replacement, Sequential Sampling, Central limit theorem with practical significance in related problems.

Statistical Inference and Testing of Hypothesis: Introduction, Estimation, Types of Estimates, Confidence interval, Tests of Hypothesis, Chi-Square distribution/test, one tails & two tails tests. Application in related problems.

Probability: Basic concepts, Permutation & Combination, Definitions of probability, Laws of probability, Conditional probability, Baye's rule. Related problems in practical significance.

Random Variables: Introduction, Discrete & Continuous random variables, Random Sequences and transformations, Probability distribution, Probability density function, Distribution function, Mathematical expectations, Moment Generating Function (M.G.F.), Markove random walks chain/Related problems.

Probability Distributions: Introduction, Discrete probability distributions, Binomial, Poisson, Hypergeometric & Negative binomial distributions. Continuous probability distribution, Uniform, Exponential & Normal distributions & their practical significance.

Text Book:
"Probability & Statistics for Engineers & Scientists" 9th edition (2011), by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying E. Ye, Publisher Prentice Hall

Reference Books:
"Applied Statistics and Probability for Engineers" 5th edition (2010), by Douglas C. Montgomery, George C. Runger, Publisher John Wiley

ME-302   SOLID MECHANICS – II

Bending Stress

Combined bending and direct stresses. Shear stresses in bending, bending and shear stresses in I-section beams. Asymmetrical bending, Shear stress in thin-walled open sections and shear center, General case of bending of a thin walled open section, Bending of initially curved bars, Beams with small radius of curvature.

Elastic Strain Energy

Strain energy under direct stress and in pure shear, Strain energy in bending and torsion, Maximum stress due to a suddenly applied load and due to impact, Bending deflection of a beam from an impact, Shear deflection, Theorems of Castigliano and Maxwell's Reciprocal Theorem.

Statically Indeterminate Beams and Frames

Double integration method; Superposition method; Virtual work; Compatibility and equilibrium methods

Stress and Strain Transformations and Relationship

Two-directional stress systems; Mohr's stress circle, Principal stresses and planes, Combined bending and torsion, Two-directional strain analysis, Normal and shear strain in terms of coordinate and maximum shear strain, Relationship between elastic constants.

Deformation Symmetrical about an Axis

Thick-walled cylinders, Compound cylinders, Shrink fit, Rotating disk of uniform thickness

Theories of Yielding
Maximum Principal Stress Theory, Maximum principal strain theory, Maximum shear stress theory, Total strain energy theory.

Thin Plates and Shells
Deflection of thin Plates, bending of circular plates with symmetrical loading, Plates with uniform loading, solid plate with different loading conditions, Axi-symmetrical thin shells, bending stresses in thin shells.

ME-306   MECHANICAL VIBRATIONS

Introduction

Main objectives, Elements of a vibratory system, Fundamental features in vibratory systems, Vectorial representation of simple harmonic motion, Degrees of freedom, Damping.

Single Degree of Freedom Systems

Undamped free vibrations, Damped free vibrations, Forced vibrations.

Two Degree of Freedom Systems

Undamped and damped free vibrations, Undamped and damped steady state forced vibrations.

Applications

Equivalent viscous damping, Balancing of machines, Vibration considerations in machine foundation.

Methods for Finding Natural Frequencies

Rayleigh method, Analytical method and graphical technique, Holzer method.

Vibrations of Elastic Bodies

Free and forced longitudinal vibrations of a uniform bar, Vibrations of a uniform bar with end masses, Free and forced lateral vibrations of simply supported thin beams, Torsional vibration of circular shaft with single rotor and two rotors, Critical speed of rotating shaft with single rotor and two rotors, Critical speed of rotating shafts.

Elementary treatment of analogue computation of vibrations, Simple cases of electromechanical systems and analogies.

ME-307   PRODUCTION ENGINEERING - II

Machining Processes and Machine Tools

Machine tools using single point tools, Description, Functions, operations performed on lathe, Shaper, planer, And boring machines, Work holding devices.

Machine tools using multiple cutting edge tools, Description, Functions, 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, and Ultra sonic 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, Sintered carbides, Ceramics, Tin-coated HSS, Diamonds and 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.

Standardization

Introduction, Product simplification and diversification, Interchangeability, Selective assembly, Principles, preparation of standards, Application of standards in design and manufacturing, applying for patents, International and national standard organizations.

Standards of length

Light waves as standard of length, Design and operation of linear measuring instruments, Slip and block gauges, Length bars, limit gauges, Sine bar, Reference temperature, Limits and fits, Hole-basis, Shaft basis comparators, Mechanical, Electrical, pneumatic and optical.

Measurement

Errors in measurement, Sensitivity, Accuracy and variation, Economics of measurement, Measurement of squareness, Flatness, Straightness, Roundness, Gear and screw threads, Advanced measuring and inspection non-contact measurement machine tool metrology, Alignment tests, Level of installation, Spindle straightness, Flatness and Squareness

Surface Texture

Roughness, Lay, Waviness and flaws, CLA and RMS values, Predication of roughness in turning, Drilling, milling and grinding.

Measurement

Measurement of roughness, Average values of roughness for various manufacturing processes.

FALL SEMESTER

MT-332   ADVANCED CALCULUS AND LINEAR ALGEBRA

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 ri-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.

Advanced Calculus

Stationary point of a function of several variables, Local maximum and saddle point for a function of two variables the stationary points of several variables, Obtain higher partial derivatives of simple functions of two or more variables, Iterated integrals, Double and triple integrations with applications (Area, Centroids, Moment of inertia, Surface area and volume, Use of 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, Evaluation of line integrals along simple paths, Application of line integrals to calculate work done, Application of Green's theorem in the plane to simple examples, surface integrals over simple surface, Use of the Jacobian to transform problem to a new coordinate system, Application of Gauss' divergence theorem to simple problems, use of Stokes' theorem to simple examples.

EE-373   MACHINE CONTROL SYSTEM

Open and closed loop control, feedback simple control system; sequence control, static switching and logic Switching Algebra.
Stability, accuracy, frequency and transient response.

Time Scale Effects

Linear control system, determination of system performance and design with reference to stability, Transient response, steady state accuracy and frequency response' Laplace transformation method; Root Locus; Nyquist criteria and Bode plots; Conformal plotting.

Series parallel and feedback techniques of system compensation.
Three term pneumatic controller for chemical plants.

Cotnrol system types; regulations, Servomechanicsm.

Electrical, hydraulic and pneumatic amplifier.

Instrumentation

Analysis of the performance of electro mechanical transducers used in control.

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 rate, 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 indentical lives, alternatives having different lives.

Production Concepts And 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 onwerhip, types of stock, partnership & joint stock companies, banking & specialized credit institutions.

Industrial Relations
Labour problems, labour organizations, prevention & settlement of disputes.

ME-303   STEAM GENERATION AND STEAM TURBINE

Properties of Steam
Steam tables, Dryness fraction, Mollier chart.

Cycles
Theoretical steam turbines cycles, Rankine, Reheat, Regenerative.

Flow of Steam through Nozzles
Critical pressure ratio, Convergent and convergent-divergent nozzles.

Steam Turbines
Impulse and reaction turbines, Compounding, Classification of turbines, Internal losses, State point locus and reheat factor.

Combined Heat and Power Schemes

Extraction and back pressure turbines.

Turbine performance and controls.

Steam Generation and Steam Plant, Feed water Heater, Air preheaters, Economizer, Superheaters.

Fuels, Fossil fuel, Coal, Oil and gas, Environmental pollution

Water Treatment
Internal and external treatment methods

ME-304   FLUID MECHANICS - II

General Theory of Two and Three Dimensional Ideal Fluid Flow:

The velocity field, Eulerian and Lagrangian viewpoints, Acceleration of flow particle, Irrotational flow, Relation between Irrotational flow and viscosity, Systems and control volumes, Potential flow, Circulation, Stream function and velocity potential, Uniform flow, Two dimensional source and sink, Simple vortex, The doublet, Lift and drag forces.

General Theory of Two and Three Dimensional Viscous Fluid Flow

Stoke's viscosity law, Navier Stokes equations of motion, Two dimensional flow between parallel plates, Flow in a circular pipe, Creep flow, Reynolds equation, Hydrodynamic lubrication in journal bearing.

Boundary Layer Theory

Boundary layer theory, Laminar boundary layer, Turbulent boundary layer, Boundary layer control, Airfoil cascades.

Fluid Machinery

Similarity relations for turbomachines, Specific speed, Classification of turbomachines, Impulse turbines, Propeller type axial-flow reaction turbine, Multi bladed reaction turbines, Radial flow pumps, Performance curves.

Computational Fluid Dynamics

Introduction, Numerical operations for differentiation and Integration, Programming procedure, Simple exercise problems

ME-305   MACHINE DESIGN

Design of Shafts:
Shafts and columns; Static, Cyclic and Shock Loads, Torsional stiffness; Critical speed; Shaft Materials and Design of Circular Shafts under normal and combined loading. Introduction to flexible shafting; Connecting rods and crank shafts.

Lubrication Theory and Bearing Design
Friction and Wear, Lubrication theory; Bearing types and materials; Detailed design of Journal and Thrust slider bearings, Design of roller bearing including spherical and tapered roller bearings.

Design of Tanks and Piping Systems
Introduction to the design of pressure vessels, tanks and piping system.

Gear Design

General gear theory; Design of the spur gear, Design of any one of the following types of gears; Helical, Worms, Bevel, Novikou and Hypoid Gears; Design of Gear Boxes and Gear Trains.

Application of Industrial Codes:

Introduction to Industrial Design Codes. Application of at least one design standards i.e. ASME, BS, ANSI, JIS, DIN, and ISO in the design of machine elements and assemblies.

Elements of Micro Electro-Mechanical Systems (MEMS)
MEMS Manufacturing; Lithography, Etching, Micromachining; MEMS Devices; Sensors, Actuators, Springs and Fluid Flow devices.

FINAL YEAR

SPRING SEMESTER

MT-441   ADVANCE 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 of Computational tools to Analyse 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 and Curve Fitting

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

Numerical Integration and Differentiation

Computation of integrals using simple Trapezoidal rule, 1/3th Simpson's rule, 1/8th 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

ME-403   REFRIGERATION AND AIR CONDITIONING

Refrigeration and Heat Pump Cycles

Carnot and Joule Cycles reversed, Vapour-compression and vapour absorption cycles, Coefficient of performance, Multiple effect compression, Processing, Multi-stage compression, Efficiencies, Properties of refrigerants and brine.

Refrigeration machines

Cold air, Vapour-compression, Steam jet and absorption types, Heat pumps, Domestic type, Auxiliaries and controls, Air cycle.

Distribution of Refrigerants

Direct expansion, Brine grids and control systems, Brine mixing and concentration, Defrosting air circulation systems.

Application of Refrigeration

Cold storage, Ice-making, Dairying, Quick freezing air-conditioning, Layouts, Load calculation and performance, Solid ice, Solar energy.

Cooling Load calculations

Use of available programs, Ashrae cooling manual.

Air-conditioning and Ventilation

Use of the psychometric charts, Calculation of heat to be removed by an air-conditioning plant, Air conditioning requirements for comfort and industrial processes, Air distributing systems, Design and sizing of ducts, Water cooler, Dehumidifiers, Humidifiers, Automatic temperature and humidity control systems, Pneumatic, electric, and hydraulic systems, Complete calculations for a simple air conditioning system, Prevention of noise and vibration, cooling towers and evaporative condensers.

ME-406   HEAT TRANSFER

Steady state conduction, General equation for three dimensional geometries, One dimensional analysis, Multi layer wall, Overall heat transfer coefficient.

Unsteady state heat transfer for simple geometries, Lumped capacitance method, Internal resistance in solid.

Transfer with internal heat sources, Extended surface heat transfer-fins.

Thermal radiation

Basic concepts, Surface characteristics blackbody, Grey body, Emission in defined wave band, Radiation intensity, Energy exchange in black and grey bodies.

Convection Heat Transfer

Basic concepts, Momentum and thermal boundary layer fundamentals, Dimensional analysis, Theoretical analysis for flat plates, Laminar and turbulent flow.

Forced Convection

Laminar and turbulent flow over flat plates and inside tubes and ducts, Empirical correlations.

Free Convection

Similarity parameter, Boundary layer, Convective coefficients in plates, Empirical correlations.

Heat transfer with change in phase, Boiling, Condensation.

Heat Exchangers

Types, Preliminary design.

Mass Transfer

Mass transfer operations, Diffusion mass transfer, Mass transfer coefficients, Empirical correlations: analogy of heat, Mass and momentum transfer, Simultaneous heat and mass transfer.

ME-415   OPERATIONS MANAGEMENT

Industrial Management & Systems: Introduction to industrial management and administration, System concept, Functions of Management, Managerial decision making, Models as decision aids.

Plant Location: Factors affecting location, Multiplant location, Location analysis, Plant layout, Types of layout, Material handling consideration in layout, Internal and External balancing, product and process layout analysis, Layout comparison.

Production Planning and Control: Product design, Pre-production planning, Production control for intermittent and continuous process; MRP (Material Requirements Planning), MRP inputs and outputs, Types of MRP; Job shop scheduling; Machine arrangement problems; Control for maximum profit; Scheduling techniques.

Quality Control: Sampling risk and economics of sampling; OC (operating characteristic) curve and sampling plan; Average outgoing quality; Sampling methods; Attribute and variable sampling, Concept of control chart, Process Variability; $\bar{X}$, R, MR, p, np, c and u charts.

Methods Analysis: Process chart; Man-Material flow charts; Work station flow charts; Man-Machine charts. Motion study; Principles of motion economy; Applications, Simo chart.

Work Measurement: Stop watch time study procedures, Timing methods, Performance rating, Total normal time, Allowance factors, Continuous production study, Work sampling procedures, Predetermined motion time techniques. Wage incentive plan and job evaluation.

Inventory Control and Forecasting: Inventory Control, Functions of Inventory, Economic order quality model, its limitations, Economic lot size, Safety stock, Stock out cost, Inventory systems, Inventory system under uncertainty, Quantity discount; Forecasting; Moving average and weight moving average; Capacity Planning

Project Management: CPM (Critical Path Method) & PERT (Project Evaluation and Review Technique).

Text Book:
"Operations Management" by Jay Heizer & Barry Render, 10th edition(2010), Publisher Prentice Hall

Reference Books:
1. "Operations Management" by William J. Stevenson, 10th edition (2008), Publisher McGraw-Hill
2. "Operations Management" by Lee J. Krajewski, Larry P. Ritzman and Manoj K. Malhotra, 9th edition (2009), Publisher Prentice Hall

ME-410   COMPUTER AIDED DESIGN / COMPUTER AIDED MANUFACTURING

COMPUTER AIDED DESIGN (CAD)

Fundamentals of CAD

Introduction, The design process, Application of computers for design, Creating the manufacturing data base, Benefits of CAD.

Hardware in CAD

The design workstation, Graphics terminal, Operator input devices, Plotters and other output devices, The central processing unit, Secondary storage.

Computer Graphics Software and Data Base

The software configuration of a graphics system, functions of a graphic package, Constructing the geometry, Data base structure and content, Wire-frame versus solid modeling, other CAD features and CAD/CAM integration.

Mathematical Elements of CAD

Two dimensional transformations, Translation, Scaling and rotation, Concatenation, Various techniques for design optimization, finite element analysis / modeling.

COMPUTER AIDED MANUFACTURING (CAM)

Conventional Numerical control

Introduction, basic components of an NC system, The NC procedure, NC coordinate systems, NC motion control systems, Applications of numerical control, Economics and justification

NC Part Programming

Punched tape in NC, tape coding and format, manual part programming, computer assisted part programming, The APT language, NC programming with interactive graphics, Voice NC programming, manual data input, APT word definitions.

Computer Controls in NC

Problems with conventional NC, NC controller technology, Computer numerical control, Direct numerical control, Adaptive control machining systems, Trends and new developments in NC.

Robotics Technology and Applications

Robot anatomy, Accuracy and repeatability, Robot specifications, End effectors, Characteristics of robot applications, Robot cell design, Types of Robot applications

ME-412   CLEAN ENERGY TECHNOLOGY

Generalities
(a) Energy and utility, planetary energy balance and energy resources, energy utilization and utilization rate, energy and ecology, energy requirements and the population explosion.
(b) Conservation of energy, energy conservation opportunities and management.
(c) Introduction to renewable energy sources: Solar, Wind, Ocean, Geothermal, Biomass including biofuels, Hydrogen coupled with other renewable sources, Hydro power, Thermoelectricity.

Solar Energy
Nature of solar radiation, insolation, architecture and types of solar collectors, Solar Plant configurations, Introduction to Photovoltaic systems, Application software.

Wind Energy
History, availability, data collection, wind turbine configurations and characteristics, principles of aerodynamics, wind turbine analysis and performance calculations, Application software.

Oceanic Energy
Types of ocean energy: Wave energy and its conversion, tidal energy, energy from currents, salination energy and the Osmotic engine, various conversion schemes and their relative merits and demerits, thermal energy and ocean thermal energy converters (OTEC).

Biomass Energy
Composition of biomass, biomass as fuel, Photosynthesis and renewable energy; production and use of biodiesel and ethanol; Merits and demerits.

Hydroelectricity
The resource, Types of hydroelectric plants, Applications, Small scale hydroelectricity, Environmental considerations.

Hydrogen Technology and Fuel Cells (FC)
Hydrogen as energy storage medium, Introduction to production and storage of hydrogen, Electrochemical cells, FC reactions, Thermodynamics and performance of FC, FC classification, FC configurations and applications.

Integration
Existing energy systems; Questions of availability, Pattern of energy use, Economic options; Long term global energy scenarios.

FALL SEMESTER

ME-401   STRESS ANALYSIS

Elementary Theory of Elasticity:

Stress at a point, Stress equation of equilibrium, Laws of stress transformation, Principal stresses, Strain and stress relations, Strain equations of transformations,
Principal strains, Compatibility, Displacement field, Basic equations and plane elasticity theory, Airy's stress functions.

Stress and Strain Measurement

Experimental, Stress analysis, Brittle-coating methods, Theory, Behavior, and Application of the stress coat, Photo-elasticity methods, Theory, Model, Materials and Analysis techniques, Bifringent coatings and scattered light, Strain measurement methods.
Introduction to strain measurement, Electrical resistance strain gauges, Parameters influencing strain gauge, Rosette analysis, Strain gauge circuits.

Elementary Plastic and Viscoelastic Analysis:

Plastic bending of beams, Plastic hinge in beams, Plastic torsion of shafts, Plastic bending or torsion in a strain hardening material.

Finite Element Analysis
Introduction; Discrete and Continuous Systems, Mathematical Models, Weighted Residual Methods, Finite element solutions

ME-413   FINITE ELEMENT ANALYSIS (FEA)

Introduction
Introduction to general Numerical Techniques; Basic concepts regarding finite element analysis; Matrix stiffness method; Minimum potential energy formulation; Recent developments.

Finite element analysis of structural problems
 Finite element modeling, element division and numbering scheme; Basic steps in FEA (Preprocessing, solution, postprocessing); Finite element Analysis of Bar element; Finite element Analysis of Truss; Finite element Analysis of Beam; Finite element Analysis of Frame.

Variational formulation and approximation
Governing Differential Equations; Transformation of Differential equation into FE equations; Treatment of boundary conditions (Elimination approach, penalty approach); Variational Formulation of boundary value problem; Methods of weighted residuals (Galerkin, Collocation, least square, subdomain); Rayleigh Ritz Method.

Isoparametric Formulation
Interpolation techniques (Triangular, Rectangular); shape functions; Lagrange interpolation function; Analysis of one dimensional problems (Linear, Quadratic, Cubic elements); Analysis of two dimensional elements; Integration on master scale, modeling, mesh generation; Gaussian Quadrature formulae, One point form, two point form.

Finite element applications and Error analysis
Convergence of solution; Various measures of errors; FEA application to Heat Transfer problems; FEA application to Fluid Mechanics problems; FEA application to Solid Mechanics problems.

Plane Elasticity
Assumptions of plane elasticity; Basic equations; Formulation of Plane stress problems; Explicit expression for Constant strain triangular element stiffness matrix; Finite element solution of a Plane stress problem.

ME-402   GAS TURBINE

Ideal Cycles

Effect of pressure, Temperature, Component efficiency on fuel and air consumption and Power of the simple plant, Inter-cooling, reheat, Heat exchanger cycles, Industrial open and closed plant.

Gas Turbine Cycles for Aircraft Propulsion

Turboprop, Turbofan and turbojet engines, Influence of altitude and flight speed on performance.

Centrifugal Compressors

Principle of operation, Work done and pressure rise, Compressibility effects, Non-dimensional quantities for plotting compressor characteristics.

Axial Flow Compressors

Elementary theory, Degree of reaction, Simple design method, Blade design, Calculation of stage performance, Overall performance, compressibility effect

Combustion Systems

Form of combustion system, Some important factors effecting combustion chamber designing, combustion process, Combustion chamber performance.

Axial Flow Turbines

Elementary theory, Vortex theory, Choice of blade profile, pitch and cord, Estimation of stage performance, Overall turbine performance.

Prediction of Performance of Simple Gas Turbines

Component Characteristics, Off-design operation of the single shaft gas turbine, Equilibrium running of a gas generator, Off-design operation of free-turbine engine, Jet engine.

ME-405   GAS DYNAMICS

Introduction

Basic governing laws, Conservation of mass, Momentum and energy, Limitations to the application of laws

Velocity of Sound

Physical differences between incompressible, sub-sonic and super-sonic gas flow, The Mach Number and Mach Angle, Optical methods of investigation.

One Dimensional Gas Flow

Isentropic flow, Choking in isentropic flow, Operation of nozzles under varying pressure ratios, Some applications of Isentropic flow.

Normal Shock Waves

Formation of shock waves, Weak shock waves, Moving shock waves, Operating characteristics of converging-diverging nozzle, One-dimensional supersonic diffusers, Supersonic pitot tube.

Oblique Shocks

Oblique shock equations, Shock geometry, Shock Polaris, Some special aspects of oblique shock waves.

Flow in Ducts

Flow in constant area ducts with friction, Performance of long ducts at various pressure ratios.

Isothermal Flow in Long Ducts

Flow in ducts with heating or cooling, Choking effects in simple stagnation temperature change, Shock waves with changes in stagnation temperature.

ME-404   NUCLEAR POWER

Nuclear Physics Review

Nuclear structure, Nuclear stability, Binding energy and mass-energy equivalence, Radioactivity (natural and artificial), Decay rate, Mean-life and half-life, Radioactive equilibrium, Nuclear reactions, Q value, Fission reaction, Elastic and inelastic scattering reactions.

Reactor Physics

Neutron reaction, Neutron flux, Cross section for scattering, Absorption and fission, Neutron diffusion Neutron leakage, Solution of diffusion equation for a bare reactor, Albedo and reflector saving, Neutron slowing down, Continuous slowing down model' Lethargy, Slowing down power, Moderation ratio, Fermi age.

Reactor Theory

Nuclear chain reactors, Criticality, The four factor formula, One group critical equation, The critical size, Non-leakage probability, Neutron life cycle.

Reactor Kinetics

Excess reactivity and reactor-period, Xenon poisoning.

Types of Nuclear Reactors

Introduction, Pressurized Water Reactor (PWR), and Primary Loop, Pressurize, Chemical Shim Control
A PWR Power plant, Boiling Water Reactor (BWR), and Load Following Control, Current BWR System
High Temperature Gas-Cooled Reactor (HTGR), Advanced Gas Cooled Reactors (AGR).

Fast Breeder Reactor and Power plants

Introduction, Nuclear Reactions, Conversion and breeding, Liquid metal fast breeder reactor (LMFBR)
Plant arrangements, LMFBR, Gas cooled Fast breeder reactor (GCFBR).

Reactor Materials

Choice of a moderator, The fuel, The coolant, Nuclear fuels.

Allied Topics

Nuclear power economics, Fuel reprocessing, Health hazard due to reactions, Shielding, Nuclear applications for peaceful purposes.

ME-416   PLANT MAINTENANCE

PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING: Basic Principles of maintenance planning, Objectives and principles of planned maintenance activity, Importance and benefits of sound maintenance systems, Reliability and Machine availability, MTBF (Mean Time Between Failures), MTTR (Mean Time To Repair), Factors of availability, Maintenance organization, CMMS (Computerized Maintenance Management System)

MAINTENANCE POLICIES: Maintenance categories (Breakdown, Preventive, Predictive), Merits and de-merits of Preventive maintenance and Predictive maintenance, maintenance schedules, RCM (Reliability Centred Maintenance) analysis

PREDICTIVE MAINTENANCE: Condition monitoring, Economics of condition monitoring, Design of a Predictive Maintenance Programme, Total Plant predictive program, Methods and instruments for Predictive Maintenance (pertaining to Vibration analysis, thermography and relevant techniques)

MAINTENANCE METHODS FOR BASIC MACHINE ELEMENTS: Shaft alignment, Rotor balancing, Bearings, Couplings, Gears and gear boxes, Compressors, Control valves, Conveyors, Lubrication, Fans, Blowers and Fluidizers, Dust Collectors, Pumps, Steam Traps and related equipment.

FAILURE ANALYSIS: Introduction to Root cause failure analysis, General Analysis Techniques, FMEA (Failure Modes and Effect Analysis), Fault-tree analysis, Cause and effect analysis, Sequence of events analysis, Root Cause Failure Analysis Methodology

TEXT BOOKS
1. "Maintenance Fundamentals" 2nd edition (2004), by R. Keith Mobley, Publisher Elsevier Butterworth-Heinemann
2. "An Introduction to Predictive Maintenance" 2nd edition (2002), by R. Keith Mobley, Publisher Butterworth-Heinemann

REFERENCE BOOKS
1. "Maintenance Engineering Handbook" 7th edition (2008), by Keith Mobley, Lindley Higgins and Darrin Wikoff, McGraw-Hill Handbooks
2. "Maintenance Engineering & Management" 2nd edition (2006), by S. K. Srivastava, Publisher S. Chand& Co.
3. "Root Cause Failure Analysis" 1999 by R. Keith Mobley, Publisher Newnes Butterworth-Heinemann

ME-409   MECHANICAL ENGINEERING PROJECT

Selected problems requiring design, 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 students and their critical evaluation through an oral examination.