Course Curriculam

COURSE CURRICULAM

Revised Curriculum and Syllabi

1) The Revised of the Curriculum is in keeping with the trends of B.E. Courses in universities and Colleges with a proper balance between science, engineering science, humanities & social science, and professional engineering subjects. Thus, a new subject "Fluid Mechanics" comes in, both because of its intrinsic need and as a prerequisite for "Heat Transfer".

The revised curriculum and syllabi come into effect for candidates Registering from Winter-2014 Examination. The old curriculum will be valid for existing candidates till 2016.

2) Elements of Safety and Environment Control have been incorporated.

3)Syllabi of all subjects have incorporated latest trends and developments.

4)Syllabi contain full details in keeping with specific requests from candidates.

5) Part 'A', 'B', and 'C' contain 08 Subjects each.

6)All earlier revisions have been carried forward especially, of Part 'D' consisting of (i) Project Work, and (ii) Viva Voce.

Send Enquiry

Part – A

AME – 01 Elementary Mathematics .

I Vector Algebra

Vectors and scalars, vector addition, resolution of vectors, scalar components, unit vectors, vector representation in three dimensions, scalar and vector product of two vectors.

II Determinants

Properties of determinants up to 3 rd order, solution of system of linear equations by Cramer's rule, with three unknowns.

III Complex Numbers

DeMoivre's theorem, roots of real and complex numbers, exponential values of sines and cosines, hyperbolic functions.

IV Differential Calculus

Differentiation and integration of hyperbolic functions. Rolle's theorem and its application, Mean Value theorems – Lagrange & Cauchy and their application. Taylor's theorem with Lagrange's and Canchy's form of remainders, Expansion of functions by Taylor's and Maclaurin's theorem, Maclaurin's infinite series expansion of Standard functions : sinx, cosx, ex, log (1+x).

Maxima and minima of functions of one variable.

V Integral Calculus:

Properties of definite integrals, fundamental theorem of integral calculus and its applications.

Arc length and surface areas of plane curves. Volume and surface area of solids of revolution. Centre of gravity.

Recommended Text Books : .

1) Differential Calculus, Dhami H.S. 1998, New Age International (P) Ltd.
2) Integral Calculus, Dhami H.S. 2001, New Age International (P) Ltd.
3) Textbook of Engineering Mathematics, Debashis Datta, 2002, New Age International (P) Ltd.
4) Engineering Mathematics – Kreszyg.
5) Pal and Das, Engg. Mathematics, vols I & II, U.N. Dhar & Brothers P. Ltd.

2. AME – 2 : PHYSICS

Geometrical Optics : Lens aberrations; longitudinal chromatic aberration, lateral chromatic aberration, two lenses in contact, two lenses separated by a distance; Monochromatic aberration; spherical aberration, coma, oblique astigmatism, curvature and field of distortion.

Interference : Relation between phase and path difference; coherent sources; Young's Double slit, Fresnel's Biprism, Lloyd's single mirror; position of Bright and Dark fringes, fringe width. Displacement of fringes; Newton's rings.

Diffraction : Fresnel and Fraunhofer diffraction, single slit and double slit diffraction, diffraction grating; introduction to reflection and transmission, resolution and Raleigh criterion, resolving power of grating.

Polarisation : Concepts, Brewester's law, double refraction, optic axis; Nicol prism. Laurent's and Bi-quartz's polarimeter.

Fibre Optics : Basic principle and application of optical fibres.

Introduction to Lasers : Stimulated absorption, spontaneous emission and stimulated emission. Characteristics of Laser light. Einstein's A and B coefficients. Population inversion, Ruby laser, helium-neon laser, argon ion laser, CO_2 laser, semi conductor lasers.

Acoustics : Simple harmonic motion, free and damped vibration, analogy with electric circuits, forced vibration, Resonance; amplitude resonance and velocity resonance and energy intake, absorption of sound; Sabine's formula (statement only), acoustic properties of buildings, production and application of ultrasonics.

Magnetism & Electricity : Biot-Savart law; magnetic fields due to a long straight conductor, a narrow circular coil, on the axis of a solenoid. Magnetic circuits, magnetomotive force, reluctance.

Alternating Current ; r.m.s. value, mean value of an a.c. current. Applications of a.c. to (i) a pure resistance, (ii) a pure inductance, (iii) a capacitor, (iv) an L-R circuit. Impedence triangle and power triangle. Application of a.c. to (i) a C-R circuit and (ii) an L-C-R circuit in series.

Recommended Books :

1) Engineering Physics, by Srivastava S.K., and Yadav R.A., New Age International (P) Ltd., Fourth Edition, 2006.

2) Physics for Engineers, by Srinivasan M.R., New Age International (P) Ltd., 1996.

AME – 3 : CHEMISTRY

Chemical Bonds :

Types of chemical bonds; ionic, covalent, coordination bonds. Theory of bonding in metals; free electron theory, valence bond theory, molecular orbital theory. Hydrogen bonding; intermolecular and intramolecular hydrogen bonding. Solid state chemistry; laws of crystallography, laws of constancy of interfacial angle, law of rationality of indices, Weiss and Miller indices, law of symmetry; plane of symmetry, axis of symmetry, centre of symmetry. Crystal lattice and unit cell. Examples of cubic, tetragonal, orthorhombic, monoclinic, triclinic, hexagonal and rhombohedral crystals. Body centered and face centred lattices.

Polymer Chemistry :

Natural and synthetic polymers, Organic and inorganic polymers, thermoplastic and thermosetting polymers, plastics, elastones, fibres and liquid resins. Addition and condensation polymers. Structure of polymers.

Chemical Kinetics :

Reaction rate and rate laws, rate constant, order of a chemical reaction; zero, first and second order reaction.

Corrosion :

Types of corrosion, theories of corrosion, factors affecting corrosion, protection from corrosion.

Water Treatment :

Types and degrees of hardness, softening of water; lime soda process, treatment of boiler feed water.

Fuel and Combustion :

Calorific value, determination of calorific value, analysis of coal.

Environmental protection :

Types and sources of air pollutants, pollution control techniques. Smog formation, acid rain, depletion of ozone layer.

Recommended Books :

• Fundamentals of Engineering Chemistry, Singh S.K., New Age International (P) Ltd., Third Edition, 2005.

4 . AME – 4 : GENERAL ENGLISH

Grammar. Usage, essays on current topics, précis, letter and technical presentation and technical report writing.

Selected pieces of prose and poetry from English literature.

AME – 05 Applied Mechanics

I Statics :

Composition and resolution of forces; moment of a force about a point and an axis ; reduction of a force system to a force and a couple, equilibrium; Lami's theorem ;coplanar non concurrent forces; Varignon's theorem; resultant of a force system.

II Friction :

Laws of Coulomb friction ; angle of friction, angle of respose and cone of friction. Simple problems applied to wedges, square threaded screws, belt friction, ropes.

III Frames and trusses

Analysis of pin jointed plane frames and trusses; method of joints,method of sections.

IV Properties of Areas and Solids

Centroid, centre of gravity, moment of inertia, polar moment of inertia, principal axes, theorems of moments of inertia, moments of inertia of rigid bodies.

V Kinematics; linear motion with uniform velocity and uniform acceleration. Projectiles; inclined projections on level ground, projections on inclined plane; relative velocity.

VI Kinetics:

D' Alembert's principle; Impulse, momentum, simple applications to motion of connected bodies.

VII Circular Motion of Rigid Bodies

Acceleration, motion on level ground, banking of roads, super elevation of rails, designed speed, skidding and overturning on banked roads.

VIII Work and Energy

Principles of work and energy applied to particle and rigid bodies, power and efficiency, simple examples. .

Recommended Books :

• Engineering Mechanics, Bhavikatti S.S. , and Rajasjekarappa K.G., New Age Intl.(P) Ltd.

• Engineering Mechanics, Irving H. Sharnes, Prentice Hall of India Pvt. Ltd. 1998.

AME – 06 INDUSTRIAL SOCIOLOGY

• Defining Sociology, Sociology and other Social Sciences – economics, political science, Psychology, history and social anthropology. The sociological perspective.

- Culture , geographical background of Indian culture, definition of culture, elements of Culture, values, beliefs, ideologies, norms, convention, etiquette, customs, traditions, fashion. Sub-culture, contra-culture, ethno – centrism, culture and socialization. Social Changes in modern India.

- Society, rural and urban communities, nature of urbanization in India, regionalism, tribal society, agrarian society, industrial society. Social groups and sub-groups.

- Impact of science and Technology on culture and civilization; the post industrial society.

- Social Stratification; social differentiation, stratification, status consistency and Inconsistency, functionalist approach to stratification, social mobility, vertical mobility.

- Urban and Industrial Sociology; sociological problems of economic development and social change. Functionalist explanation of social change, demography and social change, social factors determining fertility, morality.

- Traditional Sociology and Modernisation; meaning of modernization, complexities of modernization, Westernisation.

- Development; the role of the state and the role of the market.

- Technology Transfer; technology transfer, technology assessment, sociological perspectives on environment, influence of technology on environment.

- Labour in India; wage regulation, contract labour, women workers, bonded labour, child labour, migrant labour. Worker's adjustment and maladjustment. Incentives and disincentives.

- Industrial Relations ; grievance redressal, industrial disputes, trade unionism in India, arbitration, worker's participation in management.

Recommended Books :

- Industrial Sociology – Dr.Kumar Narain's series, Lakshmi Narain Agrawal, Agra.

- Industrial Sociology – Dr. Vatsyayan, Sixth & enlarged Edition, Kedarnath Ram Nath, Meerut & Delhi.

- Sociology …………- Parimal Kar, Central Educational Enterprises, Kolkata.

AME – 07 Strength of Materials

I Simple Stress and Strain

Stress – strain Diagram for ductile, brittle and plastic materials, concept of true modulus of elasticity,yield stress ultimate stress, working stress,proof stress, and engg.stress, factor of safety, stress coneentration, simple problems of thermal stresses and statically indeterminate problems.

II Elastic Constants :

Poisson's ratio; bulk modulus; relation between bulk modulus and Young's modulus ; modulus of rigidity and shear modulus, relation between modulus of rigidity and Young's modulus.

III. Plane stress and strain

Basic concepts; principal and principal strains ; Mohr's circle of stresses.

IV Bending of Beams:

Types of beams, supports and loads; concentrated load, uniformly distributed load, gradually varying load; bending moment and shear force diagrams;

V Stresses in Beams :

Theory of simple bending; neutral axis, moment of resistance, section modulus flexural equations. Bending stress distribution in beams.

Shear stress distribution in beams of rectangular, solid circular, and I – section beams.

VI Deflection of Beams :

Differential equation of the Elastic Curve; relation between deflection, shape, shear force and bending moment; simple problems of deflection of beams.

VII Buckling of Columns

Euler's theory ; critical loads; short and long columns.

VIII Torsion of Circular Shafts :

Torsional stress and strain, polar moment of inertia, power transmitted by a shaft. Shear stress distribution across solid and hollow shafts.

IX Thin Cylinder under Internal Pressure:

Circumferential and longitudiual stress; change in volume due to internal pressure; simple problems.

Recommended Books :

• Elements of Strength of Materials – Timoshenko.

• Strength of Materials – G.H. Rhyder.

• Strength of Materials – Basavarajaiah B.S., and Mahadevappa P.

• Strength of Materials – Popar.

AME – 08 Electrical Engineering and Basic Electronics

D.C. Circuits :

Node, branch, active and passive elements, linear and non linear circuits, bilateral network, Kirchhoff's laws, Maxwell's loop current method, star – delta transformation.

Network theorems – superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem.

Magnetic Circuits :

Magnetic quantities, B-H curve, calculations on magnetic circuits, analogy with electrical circuits.

A.C. Circuits :

Sinusoidal quantities, phase and phase difference, average and r.m.s. values, form factor and peak factor, phasor diagram, impedence and admittance, power and power factor.

Single phase a.c. circuits; series and parallel combinations of R,L,C; phasor diagram; apparent, active and reactive power; resonance in a.c. series and parallel circuits; application of network theorems to simple A.C. circuits.

Three phase a.c. circuits, balanced system, star and delta connections, phase and line quantities and their relationships, phasor diagram.

Transformers :

Types, emf equation, phasor diagrams,equivalent circuit, no load and short circuit tests, losses and efficiency, voltage regulation.

D.C. Machines :

Types, emf equation; d.c. motors; back emf, torque equation; characteristic curves of different types of motors, starting and speed control methods.

Induction Motor :

Single phase motors; capacitor start and run motors. Classification and applications.

Measuring Instruments :

Classification; torques in indicating instruments; moving iron dynamometer type instruments and their applications as ammeter, voltmeter, wattmeter, energy meter and recorders.

Semiconductors; intrinsic, N – type, P – type; the P – N junction; forward and reverse bias; junction, Zener and avalanche breakdown.

P – N Junction diode; application as rectifier, voltage doublers and waveshaping power supply. Bipolar junction transistors; biasing, characteristic, different modes of operation.

Field effect transistor; types, configuration, characteristics and use as an amplifier. Introduction to optoelectronic devices; LED, LCD,LDR, Photodetectors.Transistor as an amplifier; common emitter amplifier, the emitter follower. Feed back amplifier; positive and negative feedback, the operational amplifier (TC). Use of operators of amplifier as invertor, adder integrator, differentiator .

Push –Pull inverter circuits. Boolean functions and logic gates.

Recommended Text Books :

- Electrical Engineering and electronics, Theraja B.L., 1998, S. Chand & Co. Ltd.

- Basic Electronic Principles, Millman and Halkias.

Part – B

AME – 09 Materials Science

Atomic structure and types of bonding between atoms : Bohr's atomic model – electronic configuration of atoms, periodic classification of elements. Binding energy; ionic bonds, covalent bonds, material properties having these bonds. Electro negativity. Metallic bond – matrials properties having this bond. Intermolecular forces.

Concepts of crystal geometry : Space lattice – cubic, tetragonal, orthorhombic, rhombohedral, hexagonal, monoclinic and triclinic. Unit cell parameters to specify each crystal system. Crystal directions and planes, Miller indices.

Binding in solids : Convalent, ionic, metallic and molecular bonding. Crystal symmetry and structure. Crystalline imperfections. Point imperfections and line imperfections or dislocations, edge and screw dislocations, slip planes. Surface imperfections. Structure in silica and silicates; polymorphism in metal and ceramics; Amorphous materials – glass and polymer.

Alloys : Binary phase diagrams of important alloy systems, dendrite structure, lever rule, solid solutions, eutectic, peritectic, eutectoid and peritectoid reactions. Intermetallic compounds, sigma & other phases.

Mechanical deformation of materials : Elastic and anealstic ; plastic deformation and creep, slip and twin, dislocation theory, critical resolved sheer strees, deformation in polycrystalline material. Bauschinge's effect and elastic after effect. Work hardening; recovery, recrystalisation and grain growth, preferred orientation.

Fracture in metals and alloys : Ductile and brittle fracture, Griffith's theory, fracture toughness, ductile-brittle transition, fatigue fracture. Mechanical testing of metals.

Ceramic Materials : The structure of silica and silicates, polymorphism, fracture in glass, electrical properties of ceramic phases, refractories.

Polymers : Classification ; degree of polymerization. Formability; addition polymerization, copolymerization, condensation polymerization. Molecular structure; linear, branched, cross linked polymers. Thermoplastic and thermosetting polymers. Structure-property correlation, crystallinity, mechanical properties, applications.

Composites : General characteristics, dispersion / particulate strengthened composites, fibre reinforced composites, fabrication.

Recommended Text Books :

• Material Science, S. L. Kakani and Amit Kakani, First Edition, New Age International (P) Ltd.

• Principles of Engineering Metallurgy, L. Krishna Reddy, 1996, New Age International (P) Ltd.

• Material Science and Engineering, 7 th Edition, by William D. Callister Jr. John Willey & Sons Inc. (2006).

• Material Science and Engineering – a First Course, by V. Raghavan, 4 th Edition, Prentice Hall of India Pvt. Ltd., New Delhi (2004).

AME – 10 Production Engineering

I Metal Casting

Types of patterns and core boxes; metal flow in a mould; gating and risering ; casting proceses; green and dry sand, other sand casting processes, metal mould casting proceses, precision casting processes. Melting furnaces; casting defects, inspection and rectification.

II Metal Forming

Cold and hot working processes; various metal forming processes; punching, blanking, coining, drawing, extrusion, rolling, bending.

Hot plastic flow of metals; machine and drop forging, dies for drop forging, forging hammers and presses.

III Machining and Machine Tools

Definition of Machining and Machine Tools. Elements of Mechanics of metal cutting, types of chips, cutting tools, tool geometry, in AsA, ORS and NRS systems shear angle and shear strain, tool materials and there properties, forces on cutting tool, Merchant's circle diagram, tool failure, tool life, cutting fluids, speed, feed and depth of cut, power requirements. Various machining operations, turning, milling, shaping, planing, screw thread cutting gear cutting, grinding, super finishing, and machine tools used, motions needed for machining on respective machine tools and their structures.

IV Metrology

Use of comparators, measurement of flatness and surface finish, use of gauges; limits fits, and tolerance.

Process and Production Planning and control ;

Production planning Gantt chart, inventory control, inventory policies, economic batch quantity; Method and work study; time study, systems of rating, time standards.

V Surface Modification Technology

Case hardening by flame, case carburizing, nitriding, carbo-nitriding, coating; PVD and CVD techniques, cladding.

Recommended Text Books :

• Production Technology, Jain R.

• A Text Book of Production Engineering, Pandey P.C, Singh C.K, and Balbir Singh.

• Production Technology, O.P. Khanna and G. K. Lal, Vols- I and II.

• Materials and Manufacturing Processes, Degarro, Kohser and Black.

AME – 11 Engineering Drawing

I Introduction to IS code of drawing

Lines lettering and dimensioning

II Method of drawing geometrical curves as used in engineering practice such as parabola, ellipse, hyperbola, involute, cycloid, epicycloids and hypocycloid helix.

III Concept of First and third Angle Projection

Projection of points, lines and surfaces in first and third angle. Sections of solids and their projections.

IV Isometric projection:

Section and auxiliary views, development of srfaces and intersection of solids, Projection of nuts, bolts, rivets and riveted joints, keys, cotters, couplings.

V Machine Drawing:

Drawing of simple machine parts from pictorial views, machine drawing conventions, conventional sectioning.

Conventional representation of machine elements. Assembly and working drawings with limits, fits and finish.

VI Welding symbols:

Standard welding symbols used on drawings

Recommended Text Books :

• Engineering Drawing, Bhatt N.D., Panchal V.M., 1998, Charbotar Publishing House.

• Machine Drawing, Bhatt N. D., Panchal V.M., Charbotar Publishing House.

AME – 12 Engineering Mathematics

I Matrices : Addition and multiplication of matrices; adjoint and inverse matrix. Matrix method of solution of a system of linear equations upto three unknowns.

II Functions of several variables :

Limit and continuity; partial derivatives ; total differentials; Jacobean and problems of two variables; tangent planes and normals. Maxima, minima and saddle points; Lagrange multipliers; problems related to three variables.

III Integral Calculus :

Mean value theorem of integral calculus (no proof); Improper integrals; Beta and gamma functions and their relation (no proof) and some applications; Double and triple integrals; simple applications.

IV Infinite series:

Convergence and divergence; comparison test, D Alembert's ratio test, Gauss test, Cauchy's root test and integral test. Alternating series; tests for convergence and divergence. Power series (basic concepts).

V Ordinary Differential Equations :

Review of ordinary Differential Equations, linear and non – linear first order equations;

Second and higher order equations with constant coefficients, method of variation of parameters. Euler – Cauchy equations.

VI Fourier Series

Euler's formulae for Fourier series (without proof)

Expansion of functions in Fourier Series and in half range series.

VII Partial Differential Equations :

Boundary and initial value problems leading to P.D.E.'s. Method of solution by separation of variables. Application to one dimensional wave and diffusion equations and two dimensional Laplace equation.

Recommended Text Book :

- Textbook of Engineering Mathematics, Debashis Datta, 2002, New Age Intl. (P) Ltd.

- Differential Equations, H.T.H. Piagglo, CBS Publishers and Distribution.

- Engineering Mathematics, Pal and Das, U.N. Dhar and Sons P. Ltd.

- Engineering Mathematics, Kreyzig.

AME – 13 Fluid Mechanics

I Properties of fluids; density, specific gravity, surface tension and capillarity, viscosity.

II Fluid statics; pressure, Pascal's law, pressure variation for incompressible fluid, absolute and gauge pressure. Hydrostatic pressure on a submerged surface, force on a horizontal submerged plane surface, force on a vertical submerged plane surface.

Buoyancy and floatation; Archimedes principle, stability of immersed and floating bodies, meta centric hight.

III Kinematics of fluids; classification of fluid flow,acceleration, flow rate and continuity equation, differential equation of continuity.

IV Fluid dynamics; Euler's equation for frictionless fluid, dynamic equation with friction, energy equation, Bernoulli's equation, application to siphon,venturi, orifice.

Dimensional Analysis and Dynamic Similarity, dimensionless groups, mechanically similar flows, Reynold's number, Froude number, surface tension, other numbers. Viscosity; definition, units of dynamic viscosity, kinematic viscosity.

V Flow of incompressible fluids in Pipes; laminar and turbulent flow, critical Reynold's number, energy relations for pipe flow, friction losses in circular pipes, Hagen-Poiseuille law for laminar flow in circular pipes, velocity distribution in circular pipes.

VI Boundary Layer Flow; boundary layer, separation, transition between laminar and turbulent flow, momentum study of boundary layer, logarithmic and universal velocity distributions.

VII Fluid Measurement; Pitot tube, venturi meter, , orifice meterweirs, notches.Meters for measuring mass rate of flow.

Recommended Books :

- Introduction to Fluid Mechanics and Fluid Machines, S.K. Som and G. Biswas Tata Mcgraw Hill.

- Fluid Mechanics, A. K. Jain.

AME – 14 Heat Transfer

I Conduction : Derivation of transient heat conduction equation in 3 – D Cartesian coordinates.

II Steady state conduction (without heat generation) through a single and composite wall. Steady radial heat flow through hollow cylinder, critical thickness of insulation. Cooling by fins.

III Unsteady heat flow in a semi – infinite solid, long cylinder and sphere. Dimensionless numbers, Heisler charts.

IV Convection :

Bief review of hydrodynamic equations of boundary layer theory, analysis of thermal boundary layer by control volume, laminar heat transfer over flat plate. Fully developed heat transfer through smooth pipes. The cases of constant heat flux and constant wall temperature boundary conditions.

Overall heat transfer coefficient; dimensional analysis and dimensionless numbers.

Natural convection.

V Heat exchangers, parallel flow and counter flow heat exchangers, log mean temperature difference, NTV method.

VI Radiation :

Theory of thermal radiation; electromagnetic spectrum, Planck's law, Wien's displacement law, Stefan Boltzman equation, black and gray bodies, Kirchoff's law. Heat exchange between black and gray surface

Recommended Books :

• Heat and Mass Transfer by Nag P.K., Tata McGraw Hill & Co. Second Edition, 2007.

• Fundamentals of Heat and Mass Transfer by Kothandaraman C.P., New Age Intl.(P) Ltd., Third Edition, 2006.

• Fundamentals of Engineering Heat and Mass Transfer, Revised 2 nd Ed., R.C. Sachdeva, New Age International Publishers.

AME – 15 Welding & Allied Processes – I

Historical evolution of welding ; classification of welding processes; flame, arc,resistance, solid state etc., oxy-gas and related welding processes; characteristics of flames produced by different fuel gases, combustion chemistry of Acetylene, flame types and their applications, methods of safe handling and working, hazards and their prevention.

Electrical power in welding ; direct current & polarity, alternating current. Magnetism in welding; use of capacitor & condenser, welding transformers, rectifying brdige; half wave and full wave rectification; uses of transistor, thyristor and inductors. Hazards associated with welding power sources.

Welding Arc and the types, structure, mechanism, stability and characteristics. Temperature distribution across the Arc. Mechanism of Arc Blow, its effects and remedies; Types of Metal Transfer – short circuit transfer, types of globular transfer. Forces affecting types of Metal Transfer.

Power sources for arc welding ; static and dynamic characteristics, flat and drooping characteristics, arc stability, open circuit voltage, short circuit current, duty cycle; inverters; sine wave and square wave A.C., and D.C. power sources. Pulse welding; arc striking methods.

Principles of gas shielded arc welding; physical phenomena, operating principles of TIG, MIG/MAG and flux cored processes, inert and active gases and their effects on arc characteristics, filler materials.

TIG welding ; arc ignition methods, choice of type of current, polarity, shielding gas and electrodes type according to application, joint preparation, equipment and accessories.

MIG / MAG and flux cored Arc welding processes; equipment and accessories, metal transfer modes – dip, globular, spray, pulsed and rotating; consumables, shielding gases and filler materials. Joint preparation.

MMA; equipment and power source characteristics; Covered electrodes; types and functions of coating, slag – metal and gas metal reactions influence of coating on weld metal transfer, handling and storage, joint design.

Recommended Book :

• Welding Engineering and Technology – R.S. Parmar, M/s. Khanna Publishers, 2-B Nath Market, Nai Sarak, Delhi – 110 006.

• A Textbook of Welding Technology – O. P. Khanna.

• Welding Handbook, American Welding Society, Section-II : Gas Arc and Resistance.

• The Science and Practice of Welding, Vol-1 : Welding Science and Technology.

• The Science and Practice of Welding, Vol-2 : The Practice of Welding : A.C. Davies, Cambridge University Press (Website : www.cambridge.org (http://www.cambridge.org/)).

• Messler R.W., Principles of Welding, John Wiley & Sons, 1999.

• Welding Technology for Engineers, Eds. Baldev Raj, V. Shankar, A.K. Bhaduri, Narosa Publishing House, Third Reprint – 2009.

AME – 16 Welding Metallurgy I

Structure and properties of pure metals; crystal lattice structure types and imperfections; micro and macro structure; solid state transformation, elastic / plastic deformation, recrystallisation , cold and hot deformation, work hardening and strain ageing.

Review of Steel Making Processes; deoxidation , dephosphorisation, desulphurization and other special treatments. Defects in steels.

Classification and grouping of steel.

Principles of alloying, strengthening mechanisms – cold working, solid solution, precipitation hardening, solid state transformation; intermetallic compounds; ageing; types of phase diagrams – non, fully and partly soluble components; Principles of construction of phase diagrams and their use; the Fe – C equilibrium diagram; effects of alloying elements on the diagram, closed gamma loop, broadened gamma area; segregation and coring ; relationship between microstructure and mechanical properties. Phase transformation in steel; pearlitic, Bainitic, martensitic reaction and related properties; hardenability. Heat treatment of steels; austenitising annealing, normalizing, spheroidising, stress relieving; T-T-T and C-C-T diagrams ;isothermal, continuous cooling diagrams for welding, relationship of microstructure and hardness, microstructure and toughness.

Effects of alloying additions in steel – Ni,Cr, Mn, Si, Mo, V. High strength low alloy structural steels. Micro – alloyed HSLA steels; fine grained steels.

Structure of welds; thermal field, peak temperature, cooling rate and thermal cycle, solidification of weld pool, fusion line, HAZ, single and multipass welding. Carbon equivalent. Preheat and interpass temperature. Weldability; definition. Relation between %C and hardness and carbon equivalent and hardenability.

Recommended Text Books :

• Welding Handbook, American Welding Society, Part-I : Fundamentals of Welding.

- Metallurgy of Welding – J.L. Lancaster, Woodhead Publishing Ltd., (Website : www.woodheadpublishing.com (http://www.woodheadpublishing.com/)).

- Metals and their Weldability, Welding Handbook, Part-4, American Welding Society.

- Kou S. Welding Metallurgy, Second Ed., John Wiky & Sons Inc., 2003.

- A Textbook of Welding Metallurgy, O.P. Khanna, Dhanpat Rai & Sons.

- John C. Leopold and Damian Kotecki, "Welding Metallurgy and Weldability of Stainless Steels, Asian Ed. By permission of John Wiley & Sons Ltd., New Delhi.

Part – C

AME – 17 Engineering Economics :

I Consumer behaviour and demand: Concept and definition of demand; types of demand; demand schedule, demand curve and demand function; Laws of demand, elasticity of demand – price elasticity, income elasticity, cross elasticity; demand forecasting, methods of demand forecasting.

II Microeconomics :

Consumer behaviour, production, cross curves, types of industry and profit maximization.

III Macroeconomics :

Macroeconomics data, measuring National income, simple income determination, Government policy, major macro-economics problems.

IV Production functions: product function, period in production; total, average and marginal product, types of production function; laws of increasing, constant and diminishing returns, economies of scale.

VI Cost analysis: opportunity cost, past and future cost, avoidable and unavoidable cost, replacement cost, historical cost, incremental and sunk cost, controllable cost, production and short run cost, relationship between various costs.

VII Break even analysis: limitations, formulae for break even analysis.

VIII Markets: classification on the basis of competition, perfect competition, monopoly, bilateral monopoly, forms of price discrimination, imperfect competition, monopolistic

competition, oligopoly, duopoly; determination of equilibrium price, price control, price support and minimum price fixation, pricing strategy.

IX Sources of finance: financial accounts and management of finance; cost of capital, working capital management, capital market and money market.

Recommended Text Book;

- Managerial Economics and Financial Analysis, Siddiqui S. A., and Siddiqui A.S., 2005, New Age International (P) Ltd.

- Engineering Economics , S. K. Poddar.

AME – 18 COMPUTATIONAL METHODS AND COMPUTER PROGRAMMING

Number Systems : Positional and non-positional number systems; binary, octal, hexadecimal number systems and their interconversion. Representation of real, negative real, fined and floating point numbers; binary coded decimal and extended binary coded decimal interchange, ASCII notation.

Binary Arithmetic : Binary addition and subtraction, multiplication, division and their simple examples; Logic gates : AND, OR, NAND, NOR gates.

Elements of Computer Organisation :

CPU, Memory, I /O devices and peripherals and their role in the context of problem solving.

Languages : Assembly Language, high level language, Compiler and assembler, operating systems like DOS, WINDOWS, UNIX.

Programming in C :

The C character set, identifiers and Keywords, data types, variable names,declaration and statements.

Arithmetic, relational and logical operators, increment and decrement operators, assignment operators and expressions, bitwise operators, precedence and order of evaluation. Input and output. Conditionals and branching. Iteration, functions, and recursion. One dimensional array, pointers, multi dimensional arrays.

Structures, Unions and files.

Writing simple C programs to solve problems.

Recommended Text Books :

• Programming in C, Balaguruswamy.

• The C Programming Language, Kernighan B.W., and Ritchie D.M.

AME – 19 Testing and Quality Assurance .

 I Mechanical Testing ; hardness testing; static tension testing; stress strain curve, proportionality limit, proof stress, yield point phenomena; ductility and toughness; bend / rebend test, torsion test.

Impact toughness; Charpy test, impact toughness at low temperatures, ductile to brittle transition temperature.

II Cyclic stress; fatigue testing, S – N curves, endurance limit, fatigue fracture.

III Creep testing; stress rupture. stress corrosion testing. Proof testing

IV Weld Defects : Classification, origin and identification.

V Non destructive Testing and Inspection; Leak Testing, Liquid Penetrant inspection, magnetic particle inspection, eddy current inspection; Radiographic inspection; X-ray and gamma ray, Ultrasonic inspection, acoustic emission ^ inspection.

Radiographic inspection of pipes and tubes; use of image quality indicators.

VI Concept of quality assurance and quality control; continuous improvement, quality manual, writing quality control procedures, and quality plans for welded fabrication.

VII Introduction to Statistical Quality Control; process control and process improvement, Shewart control charts; construction and interpretation of X bar and R charts; P – chart,C-chart.

VIII Acceptance Sampling; Single, double and sequential sampling plans; O – C curves. Producer's risk and consumer's risk.

Recommended Books :

• Mix P.E. (2005), "Introduction to Non Destructive Testing", John Wiley & Sons, – New Jersey.

• Raj Baldev, Jaya Kumar T. and Tavasimuthu M. (1997)." Practical Non Destructive – Testing", Narosa Publishing House, New Delhi.

• Halmshaw. R (1996), "Introduction to Non Destructive Testing of Weld Joints," – Woodhead Publishing Ltd., Cambridge.

• Metals Handbook, Vol-17, "Non Destructive Evaluation and Quality Control", – ASM International, 1989.

AME – 20 Welding Metallurgy – II

Alloy systems ;of industrial importance and their properties; structural and high strength steels, Cr-Mo steels, stainless steels and their classification, heat resisting steels and alloys, cryogenic steels.

Cast irons ; microstructure and properties; titanium and its alloys;Al,Mg and their alloys, hard facing alloys; copper base and nickel base alloys.

Absorption of gases; in weld; O_2 , H_2, and N_2 and their effects on weld properties. Gas-metal and slag metal reactions in relation to welding; effect of electrode coating, effect of shielding gases and gas mixtures.

Cracking in welds ; cold cracking; effect of hydrogen and its control, cold cracking susceptibility. Hot cracking; solidification cracking, liquation cracking. Control of hot cracking. Reheat cracking; mechanism in weld metal and HAZ, cracking during heat treatment and multi-pass welding, control of reheat cracking. Lamellar tearing; mechanism, control by material control and joint configuration.

Residual Stress ; definition, effects on the welded fabrication; measurement and control of residual stress.

Distortion in welding ; transverse, longitudinal and angular. Factors responsible for distortion. Distortion control.

Corrosion : Electrode potential, electro-chemical series, redox potential, uniform corrosion, galvanic corrosion, stress corrosion, hydrogen embriltlement, polarization and passivity, microbiological corrosion, inhibition, anodic protection, cathodic protection; types of corrosion, inter crystalline, trans crystalline, knife line attack, pitting, crevice corrosion, protective coatings, oxidation mechanisms.

Weldability ; testing methods; weldability of different engineering alloys; C-Mn steels, stainless steels, creep resistant steels, cast irons, Ni based, Cu based and Al based alloys.

Joining dissimilar metals ; use of Schaeffler / De Long diagram, formation of intermetallic compound, carbon migration.

Protective layers and cladding ; processes for cladding , joining clad steels; corrosion resistance and wear resistance layers, surface coated and galvanized steels.

Recommended Text Books

- Metallurgy of Welding, J. F. Lancaster, Woodhead Publishing Ltd. (Website : www.woodheadpublishing.com (http://www.woodheadpublishing.com/)).

- Metals and their Weldability, Welding Handbook, Part-4,American Welding Society.

- Kou. S. Welding Metallurgy, Second Ed., John Wilby & Sons Inc., 2003.

- A Text book of Welding Metallurgy, O.P. Khanna, Dhanpat Rai 7 Sons.

- John C. Leopold and Damian Kotecki, "Welding Metallurgy and Weldability of Stainless Steels, Asian Ed. By permission of John Wiley & Sons Ltd., New Delhi.

AME – 21 WELDING APPLICATIONS

I Application of Welding in : tubular joints; T,Y, X and K joints. Stress concentration factor, concept of hot spot stress. Pipes ; welding processes for pipe joining. Pressure vessels ; classification, typical shell to shell and plate connections, head and closure design. Pressure vessel cladding. Pressure piping ; materials and welding processes.

II Welding Costs ; Analysis, Deposition Rate, Cost of Labour, Consumables, equipment and Energy; Welder's duty cycle, calculation of welding costs, return on investment.

III Welding Repair Procedure specification, Welding Repair plan, Welding Repair Procedure qualification. Welder and Welding operator qualification to be applied to Repair Welds.NDT of Weld Repair.

IV Fitness for Purpose ; Effect of Imperfection size, morphology and location on structural integrity. Typical Methods of conducting engineering critical assessment of a welded structure.

V Health, Safety and Environment Risk Assessment; hazards of electric power, problems with shielding gases, Radiation and radiation hazards to human body, eye protection, Welding fume emission, exposure, ventilation and fume extraction, Noise and ear protection, Health and Safety aspects of testing and inspection.

Recommended Text Books :

- Welding Technology and Design, Revised 2 nd Ed., V.M. Radhakrishnan; New Age International Publishers. (Website : www.newagepublishers.com (http://www.newagepublishers.com/)).

AME – 22 Welding and Allied Processes – II

Submerged Arc Welding; process principles, arc striking methods, selection of current, polarity and consumables according to application, fluxes in SAW; types – agglomerated, sintered, neutral and active fluxes, basic fluxes; joint design, single and multi wire techniques, slag – metal and gas – metal reactions.

Resistance welding; overview of spot, projection, butt, seam and flash;equipment and accessories, temperature distribution, control of welding parameters, current, pressure, time, pulse etc., typical joint preparation.

High Energy Beam Welding Processes; Laser, Electron Beam and Plasma; principles of each process; application areas of each process, equipment and accessories of each process, joint preparation, comparison between the high energy processes, hazards and safety associated with each process.

Other welding Processes – brief introduction and the field of application of electro – slag, friction, friction stir, magnetic pulse, ultrasonic, explosive, diffusion, alumino – thermic, high frequency, stud and cold pressure welding processes.

Cutting and other edge preparation processes; mechanical cutting, oxygen cutting and oxy – fuel gas cutting, principles of arc cutting processes – arc air, carbon and metal arc, oxy – arc cutting processes. Plasma cutting and gouging, laser cutting, electron beam drilling, arc and flame gouging, water jet cutting.

Surfacing and spraying; cladding techniques, spraying with powder, flame spraying, arc spraying, plasma spraying. Spraying materials, cold and fusion techniques.

Mechanised processes and robotics; differences between mechanization, automation and robotisation , sensors, narrow gap welding – SAW, MIG / MAG, TIG, orbital welding -MIG / MAG, TIG.

Brazing and Soldering ; bonding mechanisms, surface tension, wetting and capillary, survey of brazing and soldering techniques, consumables and fluxes for brazing and soldering, braze welding; soldering techniques – dip, vapour phase.

. **Recommended Text Books**

• Welding Engineering and Technology-R.S. Parmar, M/s. Khanna Publishers, 2B Nath Market, Nai Sarak, Delhi-10006.

• A Textbook of welding Technology-O.P. Khanna.

• Welding Handbook, American Welding Society, Section-II : Gas, Arc and Resistance.

• The Science and Pratice of Welding, Vol-1 : Welding Science and Technology.

• The Science andPpractice of Welding, Vol-2 : The Practice of Welding : A.C. Davies, Cambridge University Press (Website : www.cambridge.org (http://www.cambridge.org/)).

• Messler R.W., Principles of Welding, John Wiley & Sons, 1999.

• Welding Technology for Engineers, Eds. Baldev Raj, V. Shankar,A.K. Bhaduri, Narora Publishing House, 3 rd Reprint,2009

AME – 23 Design for Welding and Weld Procedure

Types of welded joints ; Butt Joint, Lap Joint, T-Joint, Cruciform Joint, Corner Joint and Edge Joint. Fillet and groove welds. Complete and Partial Joint penetration.

Grove Welds: Classification and types of grove welds, single and double fillet welds, combined partial joint penetration grove and fillet welds, size of fillet and grove welds.

Weld symbols ; standard system of representation of welded joints, brazed and soldered joints.

Design of Welded Joints : Joint design based on stresses in the structure; Joint design for structural elements such as bars, beams, plates, slabs, columns, trusses, plate girders, cylindrical shells and pressure vessels and pipe lines. Design for flanged connections.

Structural hollow sections and branch connections : Welding joint design to control distortion and shrinkage, residual stresses and cracking.

Welding Procedure : Welding Procedure Specification, Welding Procedure Qualification, Welding Procedure Qualification Record. Welding procedures for manual, semi – automatic welding by MMAW, TIG, MIG and Saw processes for materials such as carbon steel, cast iron, low alloys steels, stainless steels and Al alloys. Procedure for pre-heating and post weld heat treatment of weldments.

Introduction to ASME Section IX ; welder qualification, welding operator qualification; standard qualification tests, destructive and non-destructive. Certification of welders and welding operators.

Repair welding ; problems of repair and maintenance welding, welding repair procedure specification, welding repair procedure qualification. NDT of weld repair, welder qualification to be applied to repair welds.

Fitness for purpose ; principles, effect of imperfection size, morphology and position on structural integrity. Typical methods of conducting an engineering critical assessment of a welded structure.

Recommended Text Books

• Welding Technology and Design – V. M. Radhakrishnan, Revised Second Ed., New Age International Publishers.

• A Guide to Designing Welds – J.G. Hicks, Woodhead Publising Ltd., (Website : www.woodheadpublishing.com (http://www.woodheadpublishing.com/))

AME – 24 ADVANCED WELDING TECHNOLOGY

I Surfacing and Spraying :

 Common surfacing techniques and their principles,equipment, common problems; flame spraying with powder, flame spraying with wire, arc spraying with powder, arc spraying with wire, plasma spraying with powder. Surface preparation of the base material, spraying materials, structure of sprayed layer, substrate structure, cold and fusion techniques.

Cladding and protective layers; processes for cladding, joining of clad steels, welding procedure, Welding of linings, joint design.corrosion resistant and wear reristant layers. Coatings ; surface coated steels, galvanised steels, painting, problems of joining coated steels.

II Advanced Welding Processes ; plasma, electron beam, laser, electro-slag, friction, friction stir, magnetic pulse, ultrasonic, explosive, diffusion,stud and cold pressure welding processes; principles, equipment and accessories, wire and shielding media,application areas and quality standards.

III Advances in welding consumables and techniques in welding low weldable metals and high alloyed weld metals – titanium, magnesium, tantalum, zirconium, inconel, Cr-Ni-Mn steels, maraging steels; suitable welding processes and filler materials.

IV Joining Dissimilar Materials ; choice of processes, effect of dilution, consumables, welding problems such as formation of intermetallic compounds, carbon migration, disbonding etc., examples viz high alloyed steel with m.s., stainless steel with m.s., Ni alloys with m.s., stainless steel and copper alloys, steel and Al alloys, copper and Al alloys, Ni and Cu.

V Welding of Polymers ; hot plate, butt fusion, hot gas welding, extrusion welding, induction welding, resistance welding, implant welding, high frequency, friction, electro – fusion, ultrasonic and vibration welding, adhesive bonding.

VI Joining processes for Ceramics and Composites :

VII Computer applications in welding technology; CAD, N. C. Machines, Robotics.

Recommended Text Books

Welding Engineering and Technology-R.S. Parmar, M/s.Khanna Publishers, 2B Nath

• Market, Nai Sarak, Delhi-10006.

• A Textbook of Welding Technology – O. P. Khanna.

• Welding Handbook, American Welding Society, Section-II : Gas, Arc Resistance.

• The Science and Practice of Welding, Vol-1: Welding Science and Technology.

• The Science and practice of Welding, Vol-2: The Practice of Welding : A.C. Davies, Cambridge University Press(Website :www.cambridge.org).

• Messler R.W., Principles of Welding, John Wiley & Sons, 1999.

• Welding Technology for Engineers, Eds. Baldev Raj,V.ShankarA.K. Bhaduri, Narora Publishing House, 3 rd Reprint, 2009.

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