RAJASTHAN TECHNICAL UNIVERSITY

Teaching and Examination Scheme for B.Tech. (4 Year Course)
In
Ceramic Engineering

Year : II **Semester : III**

Code	Subject	Hrs./week			Exam Hrs.	Maximum Marks		
		L	T	P		*I.A.	Exam	Total
A. Theory Papers								
3CRE1	Ceramic Raw Materials and Characterization	3	-	-	3	20	80	100
3CRE2	Ceramic Processing	3	-	-	3	20	80	100
3CRE3	Material Science	3	-	-	3	20	80	100
3CRE4	Mathematics-III	3	1	-	3	20	80	100
3CRE5	Electronic Measurement & Instrumentation	3	-	-	3	20	80	100
3CRE6	Theory of Solid Mechanics	3	1	-	3	20	80	100
B. Practical & Sessional :								
3CRE7	Ceramic Material Analysis Lab		-	3				100
3CRE8	Mineralogy and Microscopy Lab		-	3				100
3CRE9	Electronics & Instrumentation Lab		-	3				75
3CRE10	Solid Mechanics & Machines Lab		-	3				75
3CRECS	**Discipline & Extra Curricular Activities**							50
	GRAND TOTAL	18	2	12				1000

* I.A. – Internal Assessment

RAJASTHAN TECHNICAL UNIVERSITY

Teaching and Examination Scheme for B.Tech. (4 Year Course)
In
Ceramic Engineering

Year : II **Semester : IV**

Code	Subject	Hrs./week			Exam Hrs.	Maximum Marks		
		L	T	P		*I.A.	Exam	Total
A. Theory Papers								
4CRE1	Ceramic analysis and Instrumentation	3	-	-	3	20	80	100
4CRE2	Heat and Mass Transfer	3	1	-	3	20	80	100
4CRE3	Particle and Fluid Mechanics	3	1	-	3	20	80	100
4CRE4	Electric Properties of Material	3	-	-	3	20	80	100
4CRE5	Mathematics- IV	3	1	-	3	20	80	100
4CRE6 4CRE6.1 4CRE6.2 4CRE6.3	Elective (Any one of the following) Data Base Management System Introduction to Nano-Technology Newer Machining Methods	3	-	-	3	20	80	100
B. Practical & Sessional :								
4CRE7	Instrumental & Analysis Lab	-	-	3				100
4CRE8	Heat and Mass Transfer Lab	-	-	3				100
4CRE9	Particle and Fluid Mechanics Lab	-	-	3				75
4CRE10	Computer Programming Lab	-	-	3				75
4CREDC **Discipline & Extra Curricular Activities**								50
	GRAND TOTAL	18	3	12				1000

* I.A. – Internal Assessment

3CRE1 CERAMIC RAW MATERIALS AND CHARACTERIZATION

UNIT I : Geology and its utility in ceramic industry. Broad outlines of crystal forms and symmetry, Description and classification of rocks and their formation.
UNIT 2 : Description and classification of various minerals based on their chemical compositions, Physical properties and occurence.
UNIT 3 : Study in detail of raw materials used in glass, Refractories, White wares, Potteries and cement.
UNIT 4 : Optical activity, Polarizing microscope, Isotropic and anisotropic minerals, Bi-referingence, Pleo-chroism, Propagation of light through uni-axial and bi-axial minerals, Extinction, Cleavage and interference figures, Beck's effect. Systematic description of minerals under polarizing microscope.
UNIT 5 : Chemical characteristic of raw materials of alkali and alkaline earth elements, Silica, Silicates, Alumina, Aluminates, Titania, Zirconia and and zircon, Chromatography : Introduction, Paper and thin layer chromatorgraphy, Liquid chromatography, Types of liquid chromatography, Column and detection systems. Differential thermal analysis (DTA) and thermo gravimetric analysis (TGA) with suitable examples.

3CRE2 CERAMIC PROCESSING

UNIT 1 : Ceramic fabrication processes & their classifications.
UNIT 2 : COLLOIDAL PROCESSING OF CERAMICS : Types of colloids**,** Attractive surface forces, Electrostatic, Steric and electrostatic stabilizations, Structure of consolidated colloids. Detailed study of rheology of ceramic systems. Particle sol-gel processing.
UNIT 3 : FORMING OF CERAMICS AND POWDER CONSOLIDATION METHOD : Characteristics of solid particles, Particle shapes , Size, Equivalent particle diameter, Surface area, Average particle size & size distribution.
UNIT 4 : Packing of particles, Additives in forming processes, Selection of additives, Dry pressing, Plastic forming, Slip casting and tape casting methods & extrusion.
UNIT 5 : Introduction to sintering of ceramics, Hot and iso-static processing, Binder removal, Calcinations & affecting factors.

3CRE3 MATERIALS SCIENCE

UNIT 1: CRYSTALLOGRAPHY : Crystal structure, space lattice, Bravais lattice, Miller indices, crystal symmetry. Different crystal structures: BCC, FCC and HCP. Study of AX, A_mX_p, and $A_mB_nX_{p.}$ Need for required crystal structure.

UNIT 2 : TYPE OF STANDARD CRYSTAL STRUCTURES: Structure of silicates (orthosilicates, pyrosilicates, single chain, double chain, sheet and network silicates), zeolites and polymers. Liquid crystals.

UNIT 3 : CRYSTAL IMPERFECTION : Classification of defects in natural crystals: Point, Line, Plane, Electronic imperfections, Transient imperfection. Points defects: thermodynamics of point defects, Lattice vacancies, Schottky defects, Frenkel defects, Extrinsic vacancies and colour centers. Dislocations: Introduction, edge and screw dislocations, Burger vector, slip systems, Energy of dislocations, theory of dislocation, interaction between dislocations, Mechanism of plastic deformation.

UNIT 4 : Strengthening mechanism recovery, Dislocations in crystal growth. Effects of crystal imperfection on electronics, optical and mechanical properties and technique for imperfect detemination and controlling the crystal imperfection in crystal growth.

UNIT 5 : OPTICAL PROPERTIES: Interaction of electromagnetic waves with matter. Absorption, reflection, transmittance and colour of materials. Photoconductivity: Introduction. Photo conducting materials. Electronic transition in photoconductors. Absorption and Excitation. Trapping and capture. Simple model of a photoconductor. Luminescence: Introduction. Model for luminescence in sulphide phosphors. Thallium activated alkali halides. Electroluminescence.

3CRE4 MATHEMATICS-III

UNIT 1 : LAPLACE TRANSFORM - Laplace transform with its simple properties, applications to the solution of ordinary and partial differential equations having constant co-efficients with special reference to the wave and diffusion equations.

UNIT 2 : FOURIER SERIES & Z TRANSFORM – Expansion of simple functions in fourier series. Half range series, Change of intervals, Harmonic analysis. **Z TRANSFORM -** Introduction, Properties, Inverse Z Transform .

UNIT3 : FOURIER TRANSFORM - Complex form of Fourier Transform and its inverse, Fourier sine and cosine transform and their inversion. Applications of Fourier Transform to solution of partial differential equations having constant co-efficient with special reference to heat equation and wave equation.

UNIT 4 : COMPLEX VARIABLES - Analytic functions, Cauchy-Riemann equations, Elementary conformal mapping with simple applications, Line integral in complex domain, Cauchy;s theorem. Cauchy's integral formula.

UNIT 5 : COMPLEX VARIABLES -Taylor's series Laurent's series poles, Residues, Evaluation of simple definite real integrals using the theorem of residues. Simple contour integration.

3CRE5 ELECTRONIC MEASUREMENT & INSTRUMENTATION

UNIT 1 : THEORY OF ERRORS: Accuracy & precision, Repeatability, Limits of errors, Systematic & random errors Modeling of errors, Probable error & standard deviation, Gaussian error analysis, Combination of errors.

UNIT 2 : ELECTRONIC INSTRUMENTS FOR MEASURING BASIC PARAMETERS : Electronic Voltmeter, Electronic Multimeters, Digital Voltmeter, Component Measuring Instruments, Q meter, Vector Impedance meter, RF Power & Voltage Measurements. Measurement of frequency. Introduction to shielding & grounding.

UNIT 3 : OSCILLOSCOPES : CRT Construction, Basic CRO circuits, CRO Probes, Oscilloscope Techniques of Measurement of frequency, Phase Angle and Time Delay, Multibeam, multi trace, storage & sampling Oscilloscopes. Curve tracers.

UNIT 4 : SIGNAL GENERATION: - Sine wave generators, Frequency synthesized signal generators, Sweep frequency generators.

Signal Analysis **-** Measurement Technique, Wave Analyzers, Frequency - selective wave analyser, Heterodyne wave analyser, Harmonic distortion analyser, Spectrum analyser.

UNIT 5 : TRANSDUCERS - Classification, Selection Criteria, Characteristics, Construction, Working Principles, Application of following Transducers- RTD, Thermocouples, Thermistors, LVDT, RVDT, Strain Gauges, Bourdon Tubes, Bellows. Diaphragms, Seismic Accelerometers, Tachogenerators, Load Cell, Piezoelectric Transducers, Ultrasonic Flow Meters.

3CRE6 THEORY OF SOLID MECHANICS

UNIT I: STRESS-STRAIN: Tensile, Compressive, Shear stress and strain. Stress-strain diagram, Hooke's law, Poisson's ratio, elastic constants and their relationships for a isotropic homogeneous material, thermal stresses.Composites bars, simple elastic, plastic and visco-elastic behavior of common materials in tension and compression test, concept of factor of safety and permissible stress.

UNIT 2 : Types of load, types of beams, Introduction to bending moment and shear force diagrams, bending stress and shear stress distributions in various sections viz. circular, hollow, T etc; Torsional shear stress in solid, hollow and stepped circular shafts; Concept of equivalent bending and equivalent twisting moment, Mohr's circle of stress and strain, a brief theory of elastic failures.

UNIT 3 : KINEMATICS: Elements, pairs, mechanism, four bar chain and its inversions. Velocity and acceleration, Klein construction, Instantaneous center method, synthesis of mechanism, pantograph, Scott-Russel mechanism, trifler suspension and Hooke's joint.

UNIT 4 : FRICTION: Laws of static, dynamic and rolling friction, dry & viscous friction, inclined plane and screw jack, friction axis, bearing and theory of film lubrication, clutches. Introduction to thin and thick walled cylinders.

UNIT 5 : VIBRATION :

Single Degree of Freedom Systems - Degree of freedom for dynamic analysis, Single degree of freedom system, Force-displacement relation : linearly elastic system and inelastic system, damping force, Equation of motion : external force, application of Newton's second law of motion, dynamic equilibrium stiffness, damping and mass components, mass-spring damper systems, equation of motion-earthquake excitation, combining static and dynamic responses, methods of solution of the differential equation.

Free Vibration : Un-damped, Viscously damped free vibration : types of motion, under-damped systems, decay of motion, free vibration tests.

3CRE7 CERAMIC MATERIAL ANALYSIS LAB

1. Determination of sulphate and chlorides in a given sample.
2. Determination of bicarbonates in a given sample.
3. Estimation of Na_2O, K_2O and B_2O_3 present in a sample.
4. Chemical analysis of limestone for insoluble content R_2O_3 (R = Fe, Al etc.), CaO, MgO.
5. Chemical analysis of gypsum and dolomite for insoluble content.
6. Calculate different physical parameters under load (RUL) of a given refractory.
7. Chemical analysis of a given sample of sand.
8. Thermo gravimetric analysis of a given sample.
9. Spectrophotometer analysis of given sample solution.
10. Diffferential thermal analysis of given sample.

3CRE8 MINERALOGY AND MICROSCOPY LAB

Section A: Mineralogy

1. Determination of specific gravity of mineral by Walker's steelyard balance.
2. Megascopic identification of important rock forming minerals.

Section B: Microsocopy Laboratory

3. Study of a polarizing microscope and its different parts, setting of a polarizing microscope and centering of the object.
4. Study of Becke's effect and refractive index of given materials.
5. To prepare and identify the following minerals in thin section used in ceramic industries : Quartz, orthoclase, albite, silimanite, kyanite, andalusite, gypsum, calcite, hornblende, tourmaline, muscovite, biotite, quartzite, limestone, labradorite and other ceramic materials.
6. To study X-Ray diffractometer and determine crystal structure of the given ceramic samples.
7. Characterization of the given complexes by electronic and IR spectral data.
8. Determine the size, diameter and morphology in a given sample and then categorized them on the basis of their physical dimensions using Atomic Force Microscope/Surface Tunnel Microscope.
9. Determination of grain & surface morphology of given sample & characterize them using AFM (Atomic Force Microscopy/ Surface Tunnel Microscope).

3CRE9 ELECTRONICS AND INSTRUMENTATION LAB

1 Study the following devices:
   (a) Analog & digital multimeters
   (b) Function/ Signal generators
   (c) Regulated d. c. power supplies (constant voltage and constant current operations)
   (d) Study of analog CRO, measurement of time period, amplitude, frequency & phase angle using Lissajous figures.
2 Plot V-I characteristic of P-N junction diode & calculate cut-in voltage, reverse Saturation current and static & dynamic resistances.
3 Plot V-I characteristic of zener diode and study of zener diode as voltage regulator. Observe the effect of load changes and determine load limits of the voltage regulator.
4 Plot frequency response curve for single stage amplifier and to determine gain bandwidth product.
5 Plot drain current - drain voltage and drain current – gate bias characteristics of field effect transistor and measure of I_{dss} & V_p
6 Application of Diode as clipper & clamper
7 Plot gain- frequency characteristic of two stage RC coupled amplifier & calculate its bandwidth and compare it with theoretical value.
8 Plot gain- frequency characteristic of emitter follower & find out its input and output resistances.
9 Plot input and output characteristics of BJT in CB, CC and CE configurations. Find their h-parameters.
10 Study half wave rectifier and effect of filters on wave. Also calculate theoretical & practical ripple factor.
11 Study bridge rectifier and measure the effect of filter network on D.C. voltage output & ripple factor.

3CRE10 SOLID MECHANICS LAB

1. To determine the co-efficient of friction for the given surface and samples.
2. To determine moment of inertia of the given object using of Trifler suspension.
3. Direct tensile test of the given samples.
4. Torsion test on torsion testing machine of a given sample.
5. Shear/bending test of a given sample using UTM.
6. Determination of spring constant K of the given sample using spring testing machine.
7. Fatigue testing of a given sample.
8. Impact test of given sample

4CRE1 CERAMIC ANALYSIS AND INSTRUMENTATION

UNIT 1: CRYSTALLOGRAPHY: Continuous and characteristic emission of X-rays. Absorption filters. Diffraction. Brag's Law powder and single Crystal X-ray diffractometer. Atomic scattering factor. Geometrical structure factor. Indexing of diffraction patterns, Selection rules determination of structure and lattice parameters. Applications of X-ray diffraction in ceramic systems.

UNIT 2 : SPECTROSCOPIC ANALYSIS: Introduction, Absorption and reflection techniques, Atomic techniques: emission, absorption and fluorescence, Photo acoustic spectroscopy, Microwave spectroscopy and mass spectrometers. Atomic Absorption spectrometer, paleography and its applications in analysis of ceramic systems.

UNIT 3 : GAS AND LIQUID ANALYSIS: Infrared and ultraviolet absorption analyzers, Paramagnetic oxygen analyzers, Thermal conductivity analyzers, Chemical luminescence analyzers and flame photometer and its uses in analysis. PH meters, conductivity meter analyzers for measurement of ammonia, silica, sodium and dissolved oxygen. Chromatography and its use in separation and identification of different elements.

UNIT 4 : ELECTRON MICROSCOPY: Principle construction and operation of Scanning Electron Microscope, principle construction and working of Transmission Electron Microscope (TEM), Electron diffraction Bright field and dark field images, SAD. Sample preparation of ceramic materials for SEM, TEM and EPMA.

UNIT 5 : PARTICLE SIZE, SURFACE AREA AND POROSITY MEASUREMENTS: Light scattering counter and sedimentation method for particle size, measurements. BET surface area measurements. Mercury porosity meter.

4CRE2 HEAT AND MASS TRANSFER

UNIT 1 : CONDUCTION: Heat transfer by conduction. Fourier's law, thermal resistances in series, conduction through infinites slab, thick walled cylinder and thick sphere, variation of conductivity with temperature. Convection: heat transfer through liquid. Newton's law, film coefficient, natural and forced, overall heat transfer coefficient, heat transfer coefficient based on inside and outside areas, dirt and foul factors, elementary concepts of dimensionless numbers, their use in predicting film coefficient, heat transfer to liquid under laminar and turbulent flows, forced convection outside tubes.

UNIT 2 : Radiation and furnace: Stefan-Boltzmann law, emissivity and absorbability, black and grey bodies, view factors, gas radiation, radiant heat transfer in glass melting. Furnaces: solid, liquid and gaseous fuels, their feeding devices, primary and secondary air for combustion, complete and partial combustion, calculation of radiant heat transfer in furnaces. Fuel gas: analysis and its utility, purpose of furnace linings and higher chimneys, application to steam boilers.

UNIT 3 : Heat Exchanger: Shell and tube heat exchangers, baffles, design of heat exchanger and their relative advantages, multi pass heat exchangers, mean temperature difference in co-current and counter current flows, LMTD correction factor for multi pass heat exchanger, plate heat exchanger, Current, counter current and cross-flow heat exchangers.

UNIT 4 : DIFFUSION AND DIFFUSIVITY: Fick's law, mass and molar rates of flow, different velocities and fluxes under static and moving co-ordinate system, concentration gradients in dimensional co-current and counter current flows, two film theory, analogy between mass momentum and heat transfer, mass transfer co-efficients, their experimental determination, use of dimensionless numbers, Sherwood, Lewis, Schmidt numbers.

UNIT 5 : ABSORPTION AND DRYING: absorption and desorption in packed beds and in plate columns, relative advantages. Drying: Internal flow of moisture within the solids surface evaporation drying shrinkage estimation of drying rates and achievement of maximum drying rate detail study of the various driers used in ceramic industries; tray driers, tunnel driers drum driers vacuum driers and spray driers.

4CRE3 PARTICLE AND FLUID MECHANICS

UNIT 1 : PARTICLE MECHANICS: Theory of crushing and grinding crushers grinders and ultra fine grinders. Close and open circuit grinding, selection of equipment and power requirement. Sieve analysis, cumulative and differential plots. Industrial screening equipments, Separation based on size, shape, density and surface properties.

UNIT 2 : SEPARATORS AND FILTERS: Law of motion of single particle sedimentation, free and hindred settling. Thickener and settling chambers. Flotation, rotary fluids, centrifuge, cyclone, electrostatic and magnetic separators. Pneumatic and hydraulic transportation of solids, Jansen's equation. Conveyors, bins, silos and hoppers. Different equipment for mixing of fluids and solids, mixing index.

Filtration: Flow through filter cake and medium, plate and frame filters, centrifugal filters, filter media, filter aids, washing of filter cakes, selection of filtration equipments.

UNIT 3 : BASIC DEFINITIONS AND FLUID PROPERTIES: Definition of Fluid, Incompressible and compressible fluids, Fluid as a continuum, Mass, Density, specific weight, relative density, specific volume, Bulk modulus, velocity of sound ideal fluid viscosity, Newtonian and Non-Newtonian fluid, Kinematic viscosity, Effect of temperature and pressure on viscosity, surface tension capillarity, vapour pressure and cavitations.

Fluid States : General differential equation, Hydrostatics manometry, Fluid forces on submerged surfaces. Curved surfaces, Aerostatics, Isothermal atmosphere, polytropic atmosphere.

UNIT 4 : KINEMATICS AND CONSERVATION OF MASS: Flow classifications. Fluid velocity and acceleration, streamlines and the stream function. Path lines and Rotational flow. Flownet, Laplace equation. Conservation of mass and the continuity equation for three dimensions. Equation of motion, Euler's equation of motion. Bernoulli's equation. Applications of Bernoulli's Pitot tube.

UNIT 5 : The Boundary Layer: Description of the boundary layer. Boundary Layer thickness boundary layer separation and control. The Prandtl boundary layer equation.

Flow round a body, Drag skin friction drag, pressure drag, combined skin friction & pressure drag (Profile drag) wave drag, lift induced drag . Variation of drug co- efficient with Reynolds's number.

4CRE4 ELECTRIC PROPERTIES OF MATERIALS

UNIT 1 : BAND THEORY & SOLIDS - Conductivity of metals, Mattheisen's rule, Sommerfield' model, Band theory of solids, Kronig-Penny model, Origin of energy gap, Brillouin zones, distinction between metals, insulators and semiconductors, Direct experimental evidence for band structure.

UNIT 2 : MAGNETIC MATERIALS - Classification of magnetic materials, Ferromagnetism, Diamagnetism and Paramagnetism, Origin of ferromagnetism and hysteresis loop, Domain and Magnetic anisotropy, Magnetostriction. Ferrimagnetic compounds, Spinel, Garnet. Properties: High temperature susceptibilities, Specific heat and thermal conductivity. Soft and hard magnetic materials and their applications.

UNIT 3 : POLARIZATION & DIELECTRIC MATERIALS IN STATIC FIELDS - Introduction. Polar and non-polar dielectrics, Polarization of dielectric, Clausius-Mossoti equation. Measurement of dielectric constant.

UNIT 4 : DIELECTRIC MATERIAL IN DYNAMIC FIELDS - Frequency dependence of polarisability, Dielectric relaxation. Dielectric losses and Breakdown of dielectrics, Electrets. Losses at microwave, IR & Optical frequencies

UNIT 5 : PIEZOELECTRIC & FERROELECTRIC MATERIALS - Piezoelectric effect: Introduction, theory and application of piezoelectric crystals. Ferroelectric effect: Introduction. Ferroelectric crystals, Change in crystal structure during polarization. Theory of Ferro-electricity, Ferroelectric domain, difference between ferroelectric and ferromagnetic domain. Use of ferroelectric materials.

4CRE5 MATHEMATICS IV

UNIT 1 : N**UMERICAL ANALYSIS -** Finite differences – Forward, Backward and Central differences. Newton's forward and backward differences, interpolation formulae. Stirling's formula, Lagrange's interpolation formula.

UNIT 2 : NUMERICAL ANALYSIS- Integration-Trapezoidal rule, Simpson's one third and three-eighth rules. Numerical solution of ordinary differential equations of first order - Picard's mathod, Euler's and modified Euler's methods, Miline's method and Runga-Kutta fourth order method.,Differentiation

UNIT 3 : SPECIAL FUNCTIONS – Bessel's functions of first and second kind, simple recurrence relations, orthogonal property of Bessel's , Transformation, Generating functions, Legendre's function of first kind. Simple recurrence relations, Orthogonal property, Generating function.

UNIT 4 : STATISTICS AND PROBABILITY - Elementary theory of probability, Baye's theorem with simple applications, Expected value, theoretical probability distributions-Binomial, Poisson and Normal distributions. Lines of regression, co-relation and rank correlation.

UNIT 5 : CALCULUS OF VARIATIONS - Functional, strong and weak variations simple variation problems, the Euler's equation.

4CRE6.1 DATA BASE MANAGEMENT SYSTEM

UNIT 1 :Introduction Need, purpose and goals of DBMS. DBMS Architecture, Concept of keys, Generalisation and specialization, Introduction to Relational data model, ER Modeling, Relational algebra.

UNIT 2: DATABASE DESIGN : Conceptual Data Base design. Theory of normalization, Primitive and composite data types, concept of physical and logical databases, data abstraction and data independence,. Relational calculus.

UNIT 3 : SQL : DDL and DML. Constraints assertions, views, data base security. Application Development using SQL : Host language interface, embedded SQL programming. GL's, Forms management and report writers. Stored procedures and triggers.

UNIT 4 INTERNAL OF RDBMS - Physical data organization in sequential, indexed, random and
hashed files. Inverted and multilist structures.

UNIT 5 : Transaction processing, concurrency control, Transaction model properties and state serialisability. Lock base protocols, two phase locking, Log based recovery Management.

4CRE6.2 INTRODUCTION TO NANO-TECHNOLOGY

UNIT 1 : PROPERTIES OF INDIVIDUAL NANO-PARTICLES - Meaning of nano-particle, metal nano-clusters : magic numbers, theoretical modeling of nano particles, geometric structure, electronic structure, reactivity, fluctuations, magnetic clusters, bulk to nano-transition ; semi-conducting nano-particles : optical properties, photofragmentation, coulombic explosion; rare gas and molecular clusters : inert gas clusters, superfluid clusters, molecular clusters; methods of synthesis: R F plasma, chemical methods, thermolysis, pulsed laser methods.

UNIT 2 : A. CARBON NANO STRUCTURES

Carbon Molecules : Nature of the carbon bond, new carbon structures; carbon clusters, carbon nanotubes : fabrication, structure, electrical mechanical and vibrational properties, applications of nano tubes including those in chemical sensors, catalysis, mechanical reinforcement.

B. BULK NANO-STRUCTURED MATERIALS

Solid Disordered Nanostructures : Methods of synthesis, failure mechanisms of conventional grain-sized materials, mechanical properties, nanostructured multilayers, electrical properties, arrays of nano particles in zeolites, porous silicon; nano-structured crystals including nanoparticle lattices in colloidal suspensions.

UNIT 3 : NANO STRUCTURED FERROMAGNETISM- Basics of ferromagnetism, effect of bulk nanostructuring on magnetic properties, dynamics of nano magnets, nano pore containment of magnetic particles, nano carbon ferro-magnets, giant and colossal magneto-resistance, ferro-fluids.

Nano-machines and Nano-devices : Micro-electromechanical systems (MEMSs). nanoelectromechanical systems (NEMSs), nano-devices and nano-machines.

UNIT 4 : QUANTUM WELLS, WIRES AND DOTS - Preparation of quantum nanostructures, size and dimensionality effects, excitations, applications including superconductivity

Self Assembly and Catalysis : Process of self assembly, semiconductor islands, monolayers; catalysis : nature of catalysis, surface area of nano particles, porous materials, pillared clays, colloids.

UNIT 5 : POLYMERS - Hydrocarbons, forming and characterizing polymers : polymerisation, sizes of polymers ; nanocrystals : condensed ring types, polydiacetylene types ; polymers: conductive polymers, block co-polymers; supramolecular structures : transition metal-mediated types, dendritic molecules, supramolecular dendrimers, micelles.

Biological materials including biological building blocks.

4CRE6.3 NEWER MACHINING METHODS

UNIT 1 : Introduction and classification of Advanced Machining Process, consideration in process selection, Difference between traditional and non-traditional process, Hybrid process.

UNIT 2 : MECHANICAL ADVANCED MACHINING PROCESS - Introduciton, Mechanics of Metal Removal, Process, Principle, Advantages, Disadvantages and applications of AJM, USM, WJC.

UNIT 3 : THERMO ELECTRIC ADVANCED MACHINING PROCESS - Introduction, Principle, Process, Parameters, Advantages and Disadvantages about EDM,EDG,LBM,PAM, EBM.

UNIT 4 ELECTROCHEMICAL AND CHEMICAL ADVANCED MACHINING PROCESS - ECM, ECG, ESD, Chemical Machining, Anode Shape Predition and tool design for ECM process. Tools (cathode) design for ECM process.

UNIT 5 : NON-CONVENTIONAL ABRASIVE FINISHING PROCESS - Abrasive flow machining, Magnetic abrasive finishing (for plain and cylindrical surfaces).

4CRE7 INSTRUMENTATION AND ANALYSIS LAB

1. Demonstration of DTA/Differential Enthalpy Analysis and determination of the enthalpy of a reaction and percentage weight change.
2. Demonstration of X-ray diffractometer.
3. Indexing of XRD patterns and calculation of lattice parameter.
4. Sample preparation of ceramic Materials for microstructure observation by optical microscope.
5. Spectrophotometric analysis of ceramic and glasses.
6. Demonstration of SEM/EPMA/TEM.
7. Determination of the following elements using flame photometer:
   a. Sodium and Potassium when present together.
   b. Lithium/calcium/barium/strontium.
   c. Cadmium and magnesium in tap water.
8. Thin layer chromatographic separation and identification of nickel, manganese, cobalt and zinc.
9. Determination of particles size in the given sample by using sedimentation laser method.
10. Determination of porosity in the given ceramic samples by using mercury porosity meter.
11. Analysis and measurement of ammonia, silica, sodium and dissolved oxygen by using conductivity meter.

4CRE8 HEAT AND MASS TRANSFER LAB

1&2 To determine (a) Thermal conductivity (b) Critical thickness (c) Thermal resistance of given ceramic material / insulating powder.
3. To determine the Stefan-Boltzmann constant.
4. Determination of heat transfer coefficient in natural and forced convection.
5. Determination of overall heat transfer coefficient and effectiveness for parallel and counter flow heat exchangers.
6. Determination of emissivity of a given test plate made by ceramic material with respect to black plate (standard).
7. Obtain the extraction efficiency of an agitating extractor for liquid- liquid system.
8. Study of (I) Gas inducing type agitators & (II) Cyclone separators.
9. Demonstration of effect of direction of mass heat transfer on coalescence foaming.
10. Determination of heat transfer Coefficient in natural and forced convection.

4CRE9 PARTICLE AND FLUID MECHANICS LAB

1. To classify particles/grains based on size, shape, density and surface properties.
2. To determine the terminal velocity of Cyclone separator.
3. Size reduction using Jaw & roller crusher and calculation of equivalent diameter of solid particle.
4. To analyze the given product for its particle size distribution using Sieve shaker.
5. To determine coefficient of viscosity of a given sample.
6. Determination of pressure using pressure gauge and other devices.
7. To verify Bernoulli's equation experimentally.
8. To determine the flow rate and coefficient of discharge using Venturimeter.
9. To determine the flow rate and coefficient of discharge using Orificemeter.
10. Calibration of orifice/notch.
11. Study of nature of flow using Heleshow's apparatus.

4CRE10 COMPUTER PROGRAMMING LAB

Programs in C++

1. Write a program to perform the complex arithmetic.
2. Write a program to perform the rational number arithmetic.
3. Write a program to perform the matrix operations. (Transpose, addition, subtraction, multiplication, test if a matrix is symmetric/ lower triangular/ upper triangular)
4. Implement Morse code to text conversion and vice-versa.
5. To calculate Greatest Common Divisor of given numbers.
6. To implement tower of Hanoi problem.

Program in Java

7. To implement spell checker using dictionary.
8. To implement a color selector from a given set of colors.
9. To implement a shape selector from a given set of shapes.
10. By mapping keys to pens of different colors, implement turtle graphics.
11. To implement a calculator with its functionality.
12. To implement a graph and display BFS/DFS order of nodes.