B.Tech. (Chem.Tech.)
Polymer (Plastic) Tech.
III to VIII Semester

Prospectus No. 11174

संत गाडगे बाबा अमरावती विद्यापीठ

SANT GADGE BABA AMRAVATI UNIVERSITY

(FACULTY OF ENGINEERING & TECHNOLOGY)

PROSPECTUS

PRESCRIBED FOR

FOUR YEAR DEGREE COURSE

BACHELOR OF TECHNOLOGY

(CHEMICAL TECHNOLOGY)

POLYMER (PLASTIC) TECHNOLOGY

III TO VIII SEMESTER

EXAMINATIONS, 2010-11

SEMESTER PATTERN

2010

Price Rs. **15**/-

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PUBLISHED BY
Dineshkumar Joshi
Registrar
Sant Gadge Baba
Amravati University,
Amravati. 444 602

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SYLLABUS

PRESCRIBED FOR

B.TECH. (CHEM.TECH.)

POLYMER (PLASTIC) TECHNOLOGY

SEMESTER PATTERN

THIRD SEMESTER

Inpalnt Training & Industrial Visit in the faculty of Engineering & Technology

1) a) the inplant training shall not be compulsory,

b) the inplant training shall be taken by students strickly during Summer vacation. after IVth or VIth Semester examination and / or during Winter vacation after Vth or VIIth Semester examinations,

c) the inplant training shall not be part of examination system, however, student shall prepare and submit report after completion of training to the concerned Head of Department alongwith certificate issued by the industry,

d) the inplant training shall be of minimum two weeks duration,

e) there shall not be any liability whatsoever on the Institution with respect to implant training of the students,

f) students shall undertake inplant training on their own risk and cost. An undertaking in this regards signed by student and parents shall be submitted before proceding for training to the concerned Head of Department/ Head of Institution.

g) the students shall complete inplant training under the supervision of concerned person in the industry,

h) Institutes shall help students to organise inplant training by way of correspondance,

2) Industrial Visit : Industrial visit may be organised for the students. Students should prepare & submit the report on Industrial visit to the concerned Head of Department/Head of Institution.

3SCT 1 **ELECTRICAL TECHNOLOGY**

SECTION-A

Unit I : D.C.Circuits

Basic concept of voltage, current, power of energy their relationships, Resistance, resistivity, conductivity and

temperature coefficient of resistance. Ohm's Law, Kirchoff's Laws, Superposition theorem, Thevenin's theorem delta/star and star/delta transformation. (12)

Unit II : Single Phase AC Circuit-Principle of electromagnetic induction. Self & Mutual inductance, Basic concepts of alternating quantities. Production of alternating emf, rms and average values, form factor and peak factor, wave forms and phasor diagrams, complex representation of a.c. quantities, circuits of resistance, inductance and capacitance, impedance and admittance triangles, active and reactive power. (10)

Unit III Magnetic Circuits and Transformers :

Flux, flux density mmf, reluctance and intensity of magnetic field, leakage, fringing, series & symmetrical parallel magnetic circuits.

Basic principle of operation, Construction and emf equation of a single phase transformer. Phasor diagrams, Losses in transformer, regulation and efficiency, factors governing efficiency of a transformer, basic idea of autotransformers. (14)

SECTION-B

Unit IV Balanced Three Phase Circuits ;

Prodcution of three phase e.m.f. star & delta connection phasor diagrams and waveform, Voltage, Current and power relations.

Measuring instruments :-

Classification, deflecting, controlling, damping and breaking torque. Basic principle of operation of ammeters, voltmeters, wattmeters & induction energy meter.

Unit V : Rotating Machines :

Basic idea of operation, working, speed control & appilcations of D.C. machines, 3 phase induction motor. Single phase induction motors. D.C.motor starter. Direct on line starter, Star-Delta starter for induction motor. (No-Numericals)

Unit VI Electric wiring and illumination :

Types of wires and cables, Designation of wires, Various systems of wiring and their comparison, Wiring accessories, Wiring diagrams, Domestic installation Earthing. Testing of domestic wiring installation, Safety precautions, Miniature

circuit breaker, Earth leakage circuit breaker, Principle of operation, Construction & applications of incandescent lamps, flyorescent lamps, Mercury vapour lamp, Sodium vapour lamp & Neon lamps.

Note : More stress to be given on conceptual teaching and objective questions.

PRACTICALS :

Minimum 10 practicals based on the above syllabus.

Books Recommended :

1. Basic Electrical Engineering : V.N.Mittle, TMGH
2. Electrical Technology : Edward Hughes, ELBS
3. A Text Book of Basic Electrical Engineering B.H. Deshmukh (Nirali Publication) (For Unit No.VI)

3SCECT2 APPLIED PHYSICAL CHEMISTRY-II

SECTION-A

UNIT I: ELECTROCHEMISTRY :

Conductance, Specific, Equivalent and molecular conductance their determination, independent mobility of ions, Transport number, determination of transport number by Hittorff's and moving boundary method. Debye-Huckl's theory of strong electrolytes. Concentration cells with and without transference. Standard electrode potential and its measurement, Appilcations of EMF measurements, 1. Determination of solubility and solubility product of salt, 2. Determination of pH, 3. Determination of degree of hydrolysis of salts. 4. Determination of activity and activity co-efficient. 5. To study complexes. Electrometric Titrations. Numerical. (10)

UNIT II: (A) RADIATION CHEMISTRY :

Photochemical Reactions, Laws of Photochemistry, Quantum efficiency & its experimental determination. Deviations in the law of photochemical equivalence, High quantum yield and Low quantum yield. Photosensitization, Photochemical kinetics.

(B) SPECTROSCOPY :

Electromagnetic radiation, Characteristics, Electronic

rotational and vibrational spectra, rotational energy, vibrational energy, derivation of moment of inertia for rigid rotator, wave number, instrumentation invovled in recording IR and NMR spectra and their applications. (08)

UNIT III MACROMOLECULES :

Size and shapes of Macromolecules, natural and Synthetic Macromolecules, Number average and weight average molecular weight of macromolecules and their determination by osmatic pressure, Diffusion, Sedimentation and ultracentrifuge, Viscosity and light scattering methods.(08)

SECTION-B

UNIT-IV THERMODYNAMICS :

Flame and explosion temperatures, Bond energies and heats of reaction, Principle of equipartition of energy, classical theory of Heat capacity, Quantum statistical theory of heat capacity, the partition function, Translational, rotational and vibrational partition function, Heat capacity of solids, the Einstein heat capacity equation, the Deybe's heat capacity equation. The third law of thermodynamics, statistical treatment of entropy, entropy and probability, the Sackur-Tetrode equation, the free energy function and its usefulness, The Joule Thomson effect. (10)

UNIT-V : CHEMICAL EQUILIBRIUM & KINETICS OF REACTION :

Characteristics of chemical quilibrium, Law of mass action, Equilibrium constants & their relationship, Derivation of Law of mass action from Chemical potential, Van't-Haff's reaction isotherm, isochor and isobar. Rate law, order of reaction, kinetics of first, second and third order reaction, Absolute reaction rate of Transition State Theory, Numericals. (10)

UNIT-VI (A) SURFACE CHEMISTRY :

Adsorption at surfaces, Physisorption and Chemisorption, Adsorption isoterms, Langmuir isotherm, BET isotherm, limitations of Langmuir isotherm. Determination of surface area by BET method, integral heat of adsorption and Differential heat of adsorption.

(B) CATALYST SCIENCE :

Catalyst, Characteristics of catalyst, Catalysis, Type of catalysis, Theory of heterogeneous catalysis, Catalytic Activator, Catalytic poisons, Autocatalysis. (10)

BOOKS RECOMMENDED :

1. Physical Chemistry by G.M.Barow .
2. Chemical Reaction Engineering by O.Levenspiel, Wiley Eastern Pvt.Ltd., New Delhi.
3. Introduction of Electrochemistry by S.Glasstone.
4. Thermodynamics for Chemists by S.Glasstone.
5. Fundamentals of molecular spectroscopy, By - Banwal. Tata McGraw Hills.

Practicals : Applied Physical Chemistry

1) Determination of equivalence point of titration by conductance measurement.
2) Determination of cell constant, equivalent conductance of strong electrolyte at several dilutions.
3) Determination of neutralisation point of titration between strong acid and strong base.
4) Determination of transpart number of cations and anions by Hittarf's method or by EMF measurement.
5) Determination of dissociation constant of weak acid such as oxalic acid by PH-metry titration with strong base.
6) Estimation of Bismuth, Lead, and calcium in solution with EDTA by electrometric titration.
7) To investigate the adsorption of oxalic acid or Acetic acid from aquieous solution by activated charcoal and examine the validity of freundlich and Longmuir isotherms.
8) Determination of distribution coefficient of succinic acid between ether and water.
9) Determination of Integral heat of solution of salt using Dewar's flask as calarimeter.
10) Kinetic study of first orders reaction, hydralysis of methyl acetate or inversion of cane sugar.
11) Kinetic study of saponification of ester by alkali for equimolar concentration.
12) Determination of molecular weight of polymer such as PVA. polystyrene by viscosity measurement.
13) Determination of radius of Glyceral as sucrose molecule.
14) Determination of λ max, and concentration of $CuSO_4$ in ammonia or $KMnO_4$ in H_2SO_4 by spectraphotometric method.
15) Study of phase diagram of three component system such as
(a) Acetic acid, Chloroform & Water (b) Ethanol, Ethyl acetate & Water.

(minimum 12 practicals from the above)

Books Recommended :

1) Advanced Practical Physical Chemistry by J.B.Yadav.
2) Practical Chemistry by Jahagirdar, Himalaya Publication.
3) Expermintes in Physical Chemistry By - David P.Shoemaker, Carl W.Garland, Jeffrey I.Steinfeld, Mcgraw Hill.

3SCECT3 STRENGTH OF MATERIALS

SECTION-A

Unit I : 1. Introduction : Concept of Stress and Strain, Hook's Law, Poisson's ratio.

2. Stresses and Strains in determinate and axially loaded members axial force diagrams, temperature stresses.

Unit II : Shear force and bending moment diagrams and stresses in bending and shear for determinate beams.

Unit III Stresses and Strain in determinate circular shafts subjected t to twisting moment diagrams.

SECTION-B

Unit IV 1. Thin walled pressure vessels : Thin Cylinders, Spheres.
2. Slope and deflection of beams :- Double integration, area moment.

Unit V : Stresses under combined loading :- Principle stresses and strains, direct bending torsion and bending etc.

Unit VI 1. Axially loaded columns (Euler's and Rankine's formula)
2. Strain energy under gradually applied load, suddenly applied load & impact load.

BOOKS FOR REFERENCE :

1. Strength of Materials by Singer
2. Mechanics of Structure, Vol.I by S.B.Junnarkar
3. Strength of Materials by Rammamrutham.

Practicals

Six to Eight experiments should be completed based on the syllabus of the subject and each student shall submit report/journal thereof. Practical and oral examination will be based on the syllabus and practicals.

3 SCECT4 APPLIED THERMODYNAMICS

SECTION-A

Unit I : Introduction to thermodynamics : First and Second Law of thermodynamics, Available and unavailable energy. Work from the system when it exchanges with its surrounding. Availability of steady flow and nonflow systems.

Unit II : Fules and Combustion : Types of fuels, Manufacturing of fuel Fractional distillation, Calorific values of fuels and their determination, stoichio metric air fuel gas analysis. Orsat's apparatus. Gravimetric and Volumetric analysis and their conversion. Excess air, Determination of actual quality of air from combustion analysis, coal, coke, Gas Plants, Gobar gas Plants.

Unit III Steam Boilers : Classification, Fire tube and water tube boilers Tube shape and position, firing, Head Sources, Fuel, Fluid, circulation, furnace position, furnace type, General Shape, Boiler mountings and accessories, Boiler draught.

SECTION-B

Unit IV Reciprocating Steam Engines : Rankine Cycle, Constructional features of steam Engine and its development, expansive and nonexpensive working. Simple and compound steam engines. Hypothetical and actual indicator diagrams.

2. Condensers : Jet and surface condensers, Condenser vaccum, Efficiency, Air pumps, capacity of air extraction pumps, cooling towers.

Unit V : I.C.Engines : Constructional features and development. Relative merits in comparison with steam engines. Classification, working of two stroke and four strokes Cycle engines, Air Standard, otto, Diesel and Dual cycles. Deviation of actual cycles from ideal cycles, ignition methods, valve timings, Simple carburetor, fuel pump and injector. Engine H.P., efficiencies specific fuel consumption, Heat balance, Cooling, lubrication and governing.

Unit VI Reciprocating Air Compressors : Classification, single and multistage. Effect of intercoding. Volumetric efficiency and power requirements, Air motors and vacuum pump and their applications.

RECOMMENDED BOOKS :

1. Thermal Engineering, by R.L.Ballaney - Khanna, Pub.
2. Engineering Thermodynamics, by Gupta and Prakash, nemchand and Bros, Roorkee
3. Fundamentals of I.C. Engines by Gill, Smith and Ziurys.
4. Heat Engines and Thermodynamics by S.Domkundwar, Dhanpat Rai and sons, New Delhi.

Practicals :

Ten experiment based on the above syllabus evenly distributed, shall be performed and report/journal there of should be submitted by each student.

The practicals shall consist of practicals and viva-voce based on the syllabus and practical work.

3SCECT5 PROCESS CALCULATIONS

SECTION-A

Unit I : Mathematical Principles : Graphical and numerical method of data fiting monograms, various types of graph sheets. extrapolation and integration units and dimensions, dimension analysis. stoichiometrics and composition relations. gmol, mole%, volume%, weight%, basic calculation based on simple chemical reactions. 8Hrs.

Unit II : Properties of gases. liquid and solid ideal and real laws. application of gas and standard condition. critical properties. properties of mixtures and solution partial pressure and partial volume calculation dissociating gases humidity & saturation psychometric charts. 8 Hrs.

Unit III Material Balance : With and without chemical reactions in unit operations. recycle purge bypass etc. some material balance formsteady state operations. 8 Hrs.

SECTION-B

Unit IV Thermo Physics :

Concepts and calculation involving specific heat energy enthalpy etc. of chemical reactios. 8 Hrs.

Thermo Chemistry :

Heats of formation reaction etc. effect of temperature. pressure temperature of reactions.

Unit V : Energy balance with a without chemical reactions. Steady & unsteady state processes. 8 Hrs.

Unit VI Heating value of fuels. calculations involving theoretical and excess air, heat & material alances of combustion processes. Chemical mettalurgical and other industrial processes. Industrial calculation. 8 Hrs.

Books Recommended :

1) Chemical Process Principles, Vol. I by Hougen, Watson & Ragatz. John Wiley and Sons.
2) Stoichiometry for Chemical Engineers, by Williams and Johnson.
3) Industrial Stoichemistry, by News Radash and Lewis.
4) Stoichiometry by Bhatt and Vora, Tata McGraw Hill.
5) Basic Principles & Calculations in Chemical Engg. : Himmelblau PhI.
6) Process Calculations for Chemical Engineers : D Venkat Rao, Mcmillan & Co.
7) Process Calculations for Chemical Engineers : Chemical Engg. Education, Dev.Centre, I.I.T. Madras by Durga Prasad Rao, C.H. & Murthy D.V.S.
8) Venkata Ramani, Anantaraman : Process Calculations, Prentice Hall of India's Eastern Economy Edn.
9) Gavhane K.A. : Stoichiometry, Nirali Pub.
10) Pandharipande S., Mushrif S. : Process Calculations, Pune Vidyarthi Griha Prakashan, Pune.
11) Felder R.M., Rousseau R.W. : Elementary Principles of Chemical Processes, John Wiley, 3rd ed., 2000.

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FOURTH SEMESTER

4SCT1 APPLIED MATHEMATICS II

Students are expected to be aware of the statements of the relevant theorems without mastering their proofs.

Unit I : Partial Differential Equations

Basic concepts (@11.1), Vibrating string (@11.2), separation of variables (@11.3), one dimensional heat flow (@11.5), Heat flow in an infinite bar (@11.6) (10 periods)

Unit II : Complex numbers and analytic functions

Complex numbers (@12.1), polar form (@12.2), Complex function limit, derivative analytic function (@12.4), Cauchy Riemann Equations, Laplace's Equation (@12.5), rational

functions (@12.6), Exponential function (@12.7), Trigonometric and hyperbolic functions (@12.8), logarithm (@12.9) (10 periods)

Unit III Numerical Analysis

Errors in computation (@19.1), Solution of Equations by iteration, Newton - Raphson method (@19.2) Finite differences (@19.3), Interpolation (@19.4), Numerical integration using rectangular, trapezoidal and Simpson's rule, numerical differentiation (@19-6) (10 periods)

Unit IV Optimization

Basic concepts (@22.1), Linear programming (@22.2), Simplex method (@22.3), (@22.4) (10 periods)

Unit V : Probability and Statistics

Sample mean and variance (@23.3), probability (@23.5), Permutations and combinations (@23.6), descrete and continuous distributions (@23.7), mean and variance of a distribution (@23.8), Binomial, Poisson distributions (@23.9), Normal distribution (@23.10) (10 periods)

Unit VI Probability and Statistics (continued)

Random sampling (@23.12), Estimation of parameters (@23.13), confidence intervals (@23.14), Testing of hypothesis (@23.15), Fitting straight lines (regression analysis) (@23.20) (10 periods)

Note : Numbers in bracket refer to section number in "Advanced Engineering Maths" by Erwin Kreyszig (Fifth Edn), Wiley Eastern.

Books Recommended :

1) Elements of Applied Mathematics : P.N.Wartikar & J.N. Wartikar
2) A text book of Applied Mathematics : P.N.Wartikar & J.N.Wartikar
3) Advanced Engg.Mathematics - Erwin Kreyszig, Wiley Eastern (5th Edition)
4) Higher Engg.Mathematics - B.S.Grewal.

4SPP2 POLYMER CHEMISTRY-I

SECTION-A

Unit I : Introduction to polymers. classification & types of polymers. Nomenclature. Termoplastics and thermosets. linear, branches an crosslinked polymer Block and graft copolymer.

Unit II : Manufacture and properties of some important monomers used for commercial production such as ethylene. Propylene. butadine, styrene, vinylchloride, phenol and M.M.A.

Unit III Physical and chemical methods of analysis of Monomer and Polymer. Application of IR, NMR, X-ray diffraction HPLC. GLC, TLC, to polymer analysis.

SECTION-B

Unit IV Functionality concept and determination of functional groups. carothers equation and their application principels and ditinctive features of polyaddition and polycondensation.

Unit V : Number average and weight averge molecular weight and their determination by techniques such as solution viscosities. osmotic pressure. cryoscopic method, end group analysis. ultra centrifigation and kight scatterina.

Unit VI Chemistry of polymer degradation prevention of polymer degradation and polymer stabilisation.

- Thermal Degradation - effect of high temp.
- Mechanochemical Transformation and light and Ionizing Radiation.
- Chemical degradation - Oxidation and degradation by chemical agents.

LIST OF PRACTICALS :

(1) Determination of acid value. saponification value. Iodine value. hydroxyl value of polylmer.

(2) Determination of Acetyl value, Aldehyde content & functional groups of monomer.

(3) Synthesis of Phenol formaldehyde resin ureaformaldehyde resin Nylon-06 Polystyrene Polyester PMMA.

(4) Determination of mole wt. of polymer by end group analysis.

(5) Identification of monomers like styrene, M.M.A.

Other practicals based on syllabus.

BOOKS RECOMMENDED :

(1) Principles of Polymerization - G.C.Odlon

(2) Text book of polymer chemistry - cliendsivy - Billmever (J.)

(3) Kinetic and Mechanism of Polymerisation Reactions Allen PEM Patrick C.R.John Wiley.

(4) Principles of polymerisation Engg. - Biecenbergtr J.A.Sebastian P.H.

(5) Text Book of Polymer Science by Dr.Vasant Gowarikar.

4SCECT3 MACHINE DESIGN AND DRAWING

SECTION-A

Unit I : 1. **Mechanical Engineering Design :** Traditional design methods, Design process, Design synthesis, Standardisation Limits, Fits and tolerances.

2. **Engineering Materials :** Mechanical Properties of materials I.S.designation of materials, selection of materials.

Unit II : 1. **Design for static and fluctuating loads :** Brittle and duc title/ Theories of failures, Factor of safety, stress concentration, Fluctuating Stresses, Endurance Limit, Solderberg diagrams, notch sensitivity/Materials.

2. **Shafts & Bearings :** Transmission shafting, ASME Code, Design on the basis of rigidity, Design of keys and couplings. Types of rolling contact bearing. Static and dynamic load carrying capacity, election of rolling contact bearing from manufacturers cataloge.

SECTION-B

Unit III **Bolted, Riveted and Welded joints :** Type of rivetted joints, stresses in rivets, Thin cylinders with riveted joints, Types of welded joints, welded and riveted joints subjected to accentric loading. Belted joints.

Unit IV **Belt, Chain and Gear Drivers :** Types of belts and Chains, selection of belts and chains from manufactures catalogues.

Unit V : Types of gears, Gear tooth profiles, Gear train velocity ratios, Gear tooth load for spur, helical level and worm gears, Design of spur gears.

Unit VI **Cylinders and pressure vessels :** Thick and thin cylinders, Design of pipe lines and hydraulic vavles. Introduction to design of unfired pressure vessels.

Books Recommended :

1. Mechanical Engineering Design
   by J.E.Shigley, Mc Graw hill.
2. Design of Machine Elements,
   by M.F.Spotts, Prentice Hall

DRAWING WORKS :

Drawing based on the above syllabus. Atleast four sheets of imperical size are expected.

4SCECT4 MATERIAL TECHNOLOGY

SECTION-A

Unit I : Crystalline and non crystalline structure, sensitive and structure insensitive properties and defects in crystals. Corelation of mechanical properties with reference to structure.

Unit II : Effect of temperature on mechanical properties, various methods of improving the strength failure under service conditions.

Unit III Solid solutions phase diagrams and their relation to metal properties with reference to steels and cast irons.

SECTION -B

Unit IV Heat treatment of steels and common nn ferrous alloyes.

Unit V : Elastomers and plastomers, molecular structure and properties of polymers, ceramic materials and retractories, High temperature oxide ceramics glasses and their properties, composite materials.

Unit VI Corrosion : Electrode potentials e.m.f. and galavanic series, polarization forms of corrosion, rate factors, inhibition, prevention, control and testing, Corrosion behaviour of metals and alloys chemical resistance of polymers. Forming processes and corrosion. Non destructive methods of testing, Metallic, Plastic and other protective coatings.

Books Recommended :

1. Nature and properties of Engineering Materials by D.Jastrebski.
2. Introduction to Material Science by Guy.
3. Material Science and Processes by S.K.Hajra Chaudhry.
4. Material Science for Engineers by Van Valack.

PRACTICAL

Ten experiments based on the above syllabus evenly distributed shall be performed and a report/journal there of submitted by each student.

The practical Examination shall consist of practicals and viva voce based on the syllabus and practicals.

4SPP5 MOMENTUM TRANSFER OPERATION

SECTION-A

Unit I : Introductory Concepts about Fluids, Fluid statics and Fluid Kinematics : Units and dimensions. dimensional analysis. Fluids and Non Fluids. Nature of Fluid. Compressible and incompressible. Newtonian/Non Newtonian fluid, Viscosity of fluid. Newton's law of viscosity.

Fluid Statics : Pascal Law, Hydrostatic equilibrium for compessible and incompressible fluid. U tube manometer, inclined manometer, differential manometer, inverted U manometer.

Fluid Kinematics : Types of fluid flow, potential flow fully developed flow, Steady and Unsteady flow, Uniform and non uniform flow, Laminar and turbulent flow, Reynolds number and Reynolds experiement. Description of velocity field for laminar flow through cylindrical tube between two parallel plates. Vortex flow, free vortex and forced vortex.

Unit II : Continuity equation for fluid flow (in differential form for three dimension and integral form for one dimension)

Bernoulii's equation for potential flow, Kinetic energy. correction, fluid friction in pipe flow, concepts of friction factor. Relationship between friction factor and Reynolds No., pressure drop (Head loss due to friction). f Vs. NRC chart, Head loss due to sudden enlargement, sudden contraction, frictional losses due to fittings and valves, Power requirement for flow.

Unit III Measurement of fluid flow :- Orificement, venturimeter, Rotameter, Pitot tube, Notches and Weirs. Hot wire Anemometer, quantity meter.

SECTION-B

Unit IV Transportation of fluids : Description of pipe, tubings and valves and fittings.

Pumping Devices for Liquids :

a) Centrifugal pump : Working principle, construction, Head developed by pump, Cavitation, N.P.S.H., priming, Performance and Characteristics curves, multistage pumps.

b) Positive Displacement Pump : Construction and working principle of -

1) Reciprocating Type : Piston, plunger and diaphram pump.

2) Rotary Type : Gear Pump, monopump, venetype and combination pump.

Unit V : Motion of particles through fluids, Mechanics of particle motion and equation for one dimensional motion of particle through fluid, terminal setting velocity, drag coeff. Stoke's law, Cd Vs.NRC, packed bed, loading and flooding point, fluidised bed and its types.

Unit V : Hydraulic Fluid Power : Principle of power hydraulics, hydraulic fluids, hydraulic piping, tubing, sealing.

Hydraulic valves : Relief valves, R-type, Servo valves.

Hydraulic Systems :

1) Function and application of : Hydraulic accumulator, differential hydraulic accumulator, differential hydraulic accumulator, intensifer, ram, lift, riveter, gane.

2) Hydro kinetic system such as fluid coupling and torque converters.

Hydraulic Circuits : Symbols employed in various circuits. hydraulic circuits used in plastic processing machineries.

LIST OF EXPERIEMENTS :

1. Reynold's experiement
2. To verify Bernouli's (equation) theorem.
3. To study frictional characteristics of fully developed flow.
4. To study losses in fittings.
5. To determine coefficient of discharge of venturimeter.
6. To determine coefficient of discharge of orificemeter.
7. Flow of fluid through notches.
8. To compare the coefficient of drag (Cd) and Reynolds number of sphere.
9. To study sedimentation and to determine area of thickner from Batch Test.
10. Determination of viscosity of hydraulic fluid.
11. To study charactristic curves of centrifugal and reciprocating pump.,
12. Study of various Hydraulic circuits.

Any other experiment based on the above syllabus.

LIST OF BOOKS :

1) Chemical Engineering. Vol.I, By J.M.Coulson and J.F.Richardson.
2) Momentum Transfer Operation by S.K.Gupta.
3) Unit Operations of Chemical Engineering W.L. McCabe & J.C.Smith
4) Fluid Mechanics by - Rao
5) Fluid Mechanics by - R.K.Bansal
6) Fluid Mechanics by - Modi & Seth
7) Plastics Molding Plants Vol.-I
(Hydraulics, Compression and Transfer Equipments) By - M.G.Munns. Published.

****

ENVIRONMENTAL STUDIES

Total Marks : 100

PART-A

SHORT ANSWER PATTERN **25 Marks**

1. The Multidisciplinary nature of environmental studies
- . Definition, scope and importance.
- . Need for public awareness.

(2 lecture hours)

2. Social Issues and the Environment
- . From Unsustainable to Sustainable development
- . Urban problems related to energy
- . Water conservation, rain water harvesting, watershed management
- . Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- . Envionmental ethics : Issues and possible solutions.
- . Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- . Wasteland reclamation.
- . Consumerism and waste products.
- . Environment Protection Act.
- . Air (Prevention and Control of Pollution) Act.
- . Water (Prevention and Control of Pollution) Act.
- . Wildlife Protection Act.
- . Forest Conservation Act.
- . Issues involved in enforcement of environmental lesislation.
- . Public awareness. (7 lecture hours)

3. Human Population and the Environment
- . Population growth, variation among nations.
- . Population explosion - Family Welfare Programme.
- . Environment and human health.
- . Human Rights.
- . Value Education.
- . HIV / AIDS.
- . Women and Child Welfare.
- . Role of Information Technology in Environment and human health.
- . Case Studies. (6 lecture hours)

PART-B

ESSAY TYPE WITH INBUILT CHOICE **50 Marks**

4. Natural resources :
- . **Renewable and non-renewable resources :**
  - . Natural resources and associated problems.
    - - Forest resources : Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
    - - Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
    - - Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
    - - Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer - pesticide problems, water logging, salinity, case studies.
    - - Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, Case studies.
    - - Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
  - . Role of an individual in conservation of natural resources.
  - . Equitable use of resources for sustainable lifestyles.

(8 lecture hours)

5. Ecosystems
- . Concept of an ecosystem.
- . Structure and function of an ecosystem.
- . Producers, consumers and decomposers.
- . Energy flow in the ecosystem.
- . Ecological succession.
- . Food chains, food webs and ecological pyramids.
- . Introduction, types, characteristic features, structure and function of the following ecosystem :-
  - - Forest ecosystem
  - - Grassland ecosystem
  - - Desert ecosystem
  - - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(6 lecture hours)

6. Biodiversity and its conservation
- . Introduction - Definition : genetic, species and ecosystem diversity.
- . Biogeographical classification of India.
- . Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values.
- . Biodiversity at global, National and local levels.
- . India as a mega-diversity nation.
- . Hot-spots of biodiversity.

. Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
. Endangered and endemic species of India.
. Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity. (8 lecture hours)

7. Environmental Pollution

. Definition
. Causes, effects and control measures of :-
- Air pollution
- Water pollution
- Soil pollution
- Marine pollution
- Noise pollution
- Thermal pollution
- Nuclear hazards

. Solid Waste Management : Causes, effects and control measures of
. Role of an individual in prevention of pollution.
. Pollution case studies.
. Diaster management : floods, earthquake, cyclone and landslides.
(8 lecture hours)

PART-C

ESSAY ON FIELD WORK 25 Marks

8. Field work

. Visit to a local area to document environmental assets - river / forest / grass land / hill / mountain
. Visit to a local polluted site - Urban / Rural / Industrial / Agricultural
. Study of common plants, insects, birds.
. Study of simple ecosystems - pond, river, hill slopes, etc.
(5 lecture hours)

(**Notes :** i) Contents of the syllabys mentioned under paras 1 to 8 shall be for teaching for the examination based on Annual Pattern.
ii) Contents of the syllabys mentioned under paras 1 to 4 shall be for teaching to the Semester commencing first, and
iii) Contents of the syllabys mentioned under paras 5 to 8 shall be for teaching to the Semester commencing later.

LIST OF REFERENCES :-

1) Agarwal, K.C., 2001, Environmental Biology, Nidi Publ. Ltd., Bikaner.
2) Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad - 380 013, India, Email : mapin@icenet.net **(R)**
3) Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p.
4) Clark R.S., Marine Pollution, Clanderson Press Oxford **(TB)**

5) Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T., 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p.
6) De A.K., Environmental Chemistry, Wiley Eastern Ltd.
7) Down to Earth, Certre for Science and Environment **(R)**
8) Gleick, H.P. 1993, Water in Crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press. 473p.
9) Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural Histroy Society, Mumbai **(R)**
10) Heywood, V.H. & Watson, R.T. 1995, Global Biodiversity Assessment, Ca mbridge Univ. Press 1140p
11) Jadhav, H & Bhosale, V.M. 1995, Environmental Protection and Laws, Himalaya Pub. House, Delhi. 284 p.
12) Mckinney, M.L. & Schoch, R.M. 1996, Environmental Science Systems & Solutions, Web Enhanced Edition. 639 p.
13) Mhaskar A.K., Matter Hazardous, Techno-Science Publications **(TB)**
14) Miller T.G.. Jr., Environmental Science, Wadsworth Publishing Co. **(TB)**
15) Odum, E.P., 1971, Fundamentals of Ecology, W.B.Saunders Co., U.S.A., 574p.
16) Rao M.N. & Datta A.K.,1987, Waste Water Treatment, Oxford & IBH Publ. Co. Pvt. Ltd. 345 p.
17) Sharma B.K., 2001, Environmental Chemistry, Goel Publ. House, Meerut.
18) Survey of the Environment, The Hindu **(M)**
19) Townsend C., Harper J., and Michael Begon, Essentials of Ecology, Blackwell Science **(TB)**
20) Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media **(R)**
21) Trivedi R.K. and P.K. Goel, Introduction to Air Pollution, Techno-Science Publications **(TB)**
22) Wagner K.D., 1998, Environmental Management, W.B.Saunders Co., Philadelphia, USA 499p.
23) डॉ. विठ्ठल घारपूरे : पर्यावरणशास्त्र- पिंपळापूरे ॲन्ड कंपनी पब्लीशर्स, नागपूर.**(R)**
24) Dr. Deshpande, A.P.Dr. Chudiwale, A.D., Dr. Joshi, P.P., Dr. Lad, A.B.: Environmental Studies, Pimpalapure & Co., Publishers, Nagpur. **(R)**
25) R.Rajagopalan : Environmental Studies, Oxford University Press, New Delhi, 2005 **(R)**

(M) Magazine
(R) Reference
(TB) Textbook

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FIFTH SEMESTER

5 SCECT 1 HEAT TRANSFER

SECTION-A

Unit I : Importance of heat transfer in chemical process industries. Modes of heat transfer, steady state conduction in one dimension.

Fourier's law.

Heat transfer through plane, cyclindrical and spherical walls, compound resistance in series, thermal insulation, critical and economic thickness. Extended surface equipments, types, their design & operation, introduction to unsteady state heat transfer.

Unit II : Heat transfer by convection, film concept, individual and overall coefficients and factors affecting them. Natural and forced convection. Dimensional analysis applied to heat transfer. Dittus-Boelter equation. Limitations and application.

Unit III : Heat transfer by parallel and counter current flow, concept of log mean tempeature difference, rate of heat transfer. Heat transfer by film wise and dropwise condensation in horizontal & vertical tube.

SECTION-B

Unit IV : Heat exchange equipments and their design, double pipe, parallel, counter current, shell and tube heat exchangers, condensers, fouling factors, concepts of transfer units in heat exchangers, NTU concept for heat exchangers.

Unit V : Boiling & Evaporators : Theory of boiling. Classification, types and field applications of evaporators. Single and multiple effect evaporators.

Heat transfer through submerged coils, jacketted vessels.

Unit VI : Heat transfer by radiation, concept of black body, Kirchoff's law, Stefan's law, Black and gray body radiation, view factors

luminous and non-luminous gases. Heat transfer in packed and fluidised beds.

Recent developments in heat transfer.

PRACTICALS : Based on above syllabus.

BOOKS RECOMMENDED :

1) Heat Trasnfer : Mc Adams

2) Heat Transfer : Sukhatme
3) Basic Heat Transfer : Necati Orisik, McGraw Hill Co., Kogakusha.
4) Heat Transfer : J.P.Hokman, McGraw Hill Co., Kogakusha.
5) Unit Operations of Chemical Engg. : McCab and Smith.
6) Introduction to Chemical Engg. : Bedger and Banchero.
7) Chemical Engg. : Coulson & Richardson, Vol. I (ELBS, Pergamon Press, 1970)
8) Heat Transfer : Gebhart, McGraw Hill, 2nd edition, 1979.
9) Fundamentals of Engg. : R.C.Sachdeva, Wiley Eastern.
10) Heat Transfer : R.C.Sachdeva.
11) Dutta : Heat Transfer - Principles and Applications, Prentice Hall of India's Eastern Economy Edn.
12) Dawande S.D. : Principles of Heat Transfer and Mass Transfer, Central Techno Pub., Nagpur.
13) Donald & Kern : Process Heat Transfer, Tata McGraw Hill Pub.Co.
14) Wetly J.R., Wilson R.E., Wicks C.E. : Fundamentals of Momentum, Heat and Mass Transfer, John Wiley & Sons, New York, 4thEd.2000

5SPP2 CHEMICAL ENGINEERING OPERATION-I

(MECHANICAL OPERATIONS)

SECTION-A

Unit I : Storage, handling and transportation of solids such as plastic granules, additives like fillers powders. Screening, sieve analysis, partical size distribution, differential and cumulative analysis.

Unit II : Laws of power requirements for size reduction, crushing and grinding operations. Equipments used in size reduction in polymer/plastics industries.

Unit III : Mixing and agitation - Theory of mixing & agitation. Equipments of mixing of solids, pastes and highly viscous media, compounding equipments, intensive dry mixers, internal intensive batch mixer, continuous mixer, two roll mill, single and twin screw extruder, compounder extruder. Agitating vessels.

SECTION-B

Unit IV : Principle of gravity settling, drag force, terminal settling velocity, free settling and hindered settling, sedimentation, continuous thickers.

Unit V : Centrifuges - Theory, types and description of equipments. cyclone separators, hydrocyclones.

Unit VI : Filtration : Principle of filtration (detailed calculations are not expected) equipments for filtration. Flotation, agents for flotation, flotation cell.

PRACTICALS : Based on above syllabus.

BOOKS RECOMMENDED :

1. Momentum Transfer Operation : S.K.Gupta, Tata McGraw Hill, 1979
2. Unit Operations of Chemical Engineering : McCabe and Smith (McGraw Hill 3rd Ed.)
3. Chemical Engineering Vol.1 : Coulson and Richardson (Pergamon 1979)
4. Principles of Unit Operations : A.S.Foust (Wiley Toppan International 1960)
5. Unit Operations : C.G.Brown
6. Introduction to Chemical Engg. : Badger and Banchero
7. Mass Transfer Operations : R.E.Treybal

5SPP3 POLYMER CHEMISTRY-II

SECTION-A

Unit-I STEP POLYMERISATION : Chemistry and Mechanism of polycondensation reaction, functional groups, kinetics of polycondensation reaction reactivity of equivaluer step co-polymerization, some important step polymer, such poicarbonate, Aromatic-sulphones, Aromatic Polyamides, Aromatic Polyethers, Aromatic Sulfides.

Unit-II RADICAL CHAIN POLYMERISATION : Introduction to radical chain Polymerisatin, Comparison of radical and step polymerisation. Chemistry and mechanism of radical chain polymerisation.

INITIATION : Thermal decomposition of initiator, Kinetics of intiation.

RADIX INITIATION : Type of radix initiations, Photochemical initiations bybulk monomer, irradiation of thermal and radix initiation.

INITIATOR EFFICIENCY : Mechanism of Lowering or initiator efficiency experimental determination of initiator efficiency.

Unit-III IONIC CHAIN POLYMERISATION

CATIONIC CHAIN POLYMERISATION : Comparison of ionic chain polymer withradical chain polymer, Initiations by Protonic acids Lewis acids Propagation. Termination by chain transfers, combination with counter ions and backbiting. Inhibitors and Retarders.

ANIONIC CHAIN POLYMERISATION : Comparison of cationic withanionic chain polymerisation. Initiation by nucleophilic initiators, Electron transfer, Various modes of termination such as termination by added transfer agents, hydride elimination and polar monomer.

SECTION-B

Unit-IV COPOLYMERISATION : Chemistry of block, graft, random and alternate copolymer Free-radical-copolymerisation. Monomer reactivity ratio and its determination. Co-relation between monomer reactivity ratio and copolymer structure. Factor affecting monomer reactivity. Alfray price equation.

Unit-V STEREO-CHEMISTRY OF POLYMERISATION : Introduction to isomerism, Tacticity stereo-chemistryof Polymeriaction of monosybstituted ethylenes disabstituted ethylenes, 1.3-butadience properties of stereogular polymer. Mechamisum of sterespecific placement.

ZIEGLER-NATTA POLYMERIZATION : Componments of ziegler Natta Catalyst. Effect of the compoments on zigler Natta initiator system. Mechanisum of ziegler Natta polymerisation. Metallocene catalysts for polyoleffins, its mechanism.

Unit-VI Chemistry of Thermoseting Polymers. Chemistry of synthetic and crosslinking thermosetts, such as phenolics, aminoresins, epoxides, unsaturuted polyester and polyurathens.

PRACTICALS : Based on above syllabus.

BOOKS RECOMMENDED

1. Principales of Polymerisation : C.C.Odin
2. Structure and Mechanism in Vinyl Polymerisation : Marcell Decker
3. Kinetics and Mechanism of Polymerisation Reaction PEM Allen & C.R. Patrick.
4. Text Book of Polymer : Cliendslvy Vilmeyer

5. Copolymerisation : G.C.Man Marcel Decker
6. Principals of Polymer Chemistry - P.G.Flory
7. Polymer Chemistry : Bruno vollmart
8. Polymer Science & Tech. of Plastics & Rubber : P.Ghosh
9. Physical Chemistry of Polymer - Tager
10. Polymer Science : V.Gowarikar

5 SPP 4 POLYMER MATERIALS

SECTION-A

Unit I : Histroy and development of polymer materials. Basic raw & IImaterials for polymer and their availability, Production, Properties and applications of PVC.

Unit II : Prooduction, properties and applications of HDPE, LDPE, LLDPE and PP.

Unit III : Production, Properties & applications of Acrylic Plastics and Styrenic Polymers.

SECTION-B

Unit IV : Production, Properties & applications of Engineering plastics such as Polycarbonate, PPO, PPS, ABS, PET, Polyamide, polyimides, Fluro Polymers. Acetal resins.

Unit V : Thermoset Technology, production, properties & applications of Phenolics, Urea, Melamine resins. Production, properties & application of Cellyl and Epoxy resins, unsaturated Polyesters.

Unit VI : Polyurethane resins : Review and introduction of recent advances in polymer materials such as light emitting polymers, Conducting polymers, polymers for ion exchange resins and membranes. Biodegradable polymers such as P.H.B.

PRACTICALS : Based on above Syllabus.

BOOKS RECOMMENDED :

1) Plastic Materials : J.A.Brydson
2) Encyclopedia of PVC, Vol. I, II & III : L.I.Nass.
3) Manufacture of Plastics : Maya Smith.
4) Vinyl & Diene Monomers Part I & II : E.C.Leonard.
5) Fibers Fillers Plastics & Rubbers : W.J.Roff.
6) Plastics Materials Proof & Application (1, 2, 3) : Birley.
7) Hand Book of Plastics & Elastomers : Harmansen.

8) Plastic Materials Handbook : Athalye.
9) Handbook of Plastics Materials & Technology : Rubin.
10) Polymer Science & Technology of Plastics & Rubbers : P.Ghosh.

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5 SCECT 5 ECONOMICS AND MANAGEMENT

SECTION-A

Unit I : Nature and Scope of Economics, introduction to managerial economics.

Demand concepts : Demand specification, types of demand.

Demand analysis : law of diminishing utility, Consumer's surplus.

Demand forecasting : Concept of forecasting, types of forecasts.

Unit II : Production Concept, production function, Laws of return, scales of production, factors of production, production planning and control : Its meaning, essential factors for the success of production planning and control.

Unit III : Meaning of Management, Principles of management, meaning and principles of scientific management, levels of management, delegation and authority, Organisation, forms of organisation.

SECTION-B

Unit IV : Sources of Finance Banking and Credit structure in India : Financial institutions, promotional polices and programmes of industrialisation, functions of Commercial Banks, functions of Central Bank.

Unit V : Economic and Social Environment : Brief idea about economic environment of business, socio-cultural environment, Health hazards of chemical industries, awareness about AIDS & other diseases.

Brief idea about economic recession & its effect.

Introduction to World Trade, Glogalisation, Libertion and their effects.

Introduction to patenting & intellectual property protection.

Unit VI : Entrepreneur and Entrepreneurship :

Entrepreneurial competencies, institutional interface for small scale enterprises, opportunity scanning and identification.

Market assessment for SSE, choice of technology and selec-

tion of site, Ownership structure and organisational framework, preparation of business plan, main features of Indian factories act & minimum wage act.

Brief idea of Taxation in India.

BOOKS RECOMMENDED :

1) Managerial Economics : K.K.Seo, Richard D. Irwin Inc.
2) Engineering Economics : J.L.Riggs, McGraw Hill, New York, 2nd edition, 1982.
3) Managerial Economics : Adhikary M., Khosla Pub. House, New Delhi.
4) Small Business Management Fundamentals : Dan Strenhoff and J.F.Burgess, McGraw Hill Book Company.
5) Effective Small Business Management : Richard M.Hodgills, Academic Press Incorporated, Harcourt, Brace Jovanovich.
6) Marketing Management for Small Units : Jain Vijay K., Management Publishing Co., 1988.
7) Marketing Management :- Analysis, Planning, Implementation and Control : Kotler, Phillip, Prentice Hall of India Pvt. Ltd., 6th ed., 1988.
8) Modern Economics Theory : K.K.Dewett.
9) Ferguson and Maurice, Richard D. : Economic Analysis Theory and Applications, Erwin Inc.
10) Slowman John : Economics, Financial Times, PHI, 4th ed., 2000.

5 SRNCECT 6 COMMUNICATION SKILLS

Unit I : Comprehension over an unseen passage.

Comprehension - A - word study :-

Synonym, antonym, meanings, matching words, adjectives, adverbs, prefix and suffix, correct forms of commonly misspelled words, understanding of the given passage.

Comprehension - B - Structure study :-

Simple and compound sentences, types of conjunctions, singular and plural, tenses and their effect on verb forms. Use of - not only - but also, if clause, since, may, can, could, would, too etc.

Active and passive forms, negative and interrogative, punctuation and capitalization. (10 Hours)

Unit II : Theoretical background - importance of communication, its process, model of communication its components & barriers.

Verbal communication, its significance, types of written communication, organization of a text (Titles, summaries, headings, sequencing, signaling, cueing etc.), Important text factors (length of paragraph, sentences, words, clarification and

text difficulty). Evaluation of written communication for its effectivity and subject content.

Non-verbal communication, types of graphics and pictoral devices. (10 Hours)

Unit III : Specific formats for written communication like - business correspondence, formal reports, technical proposals, research papers and articles, advertising and graphics. Format for day-to-day written communication like applications, notices, minutes, quotations, orders, enquiries etc.

Oral communications - Important objectives of interpersonal skills, (verbal and non-verbal), face to face communications, group discussion and personal interviews.

Methodology of conduction of meetings, seminars, symposia, conference and workshop. (10 Hours)

BOOKS RECOMMENDED :

1) Krishna Mohan, Meera Banerjee : Developing Communication Skills, MacMillan India Limited.
2) Chrissie Wright (Editor) : Handbook of Practical Communication Skills, Jaico Publishing House.
3) Curriculum Development Centre, TTTI WR, Bhopal : A Course in Technical English, Somaiya Publication Pvt. Ltd.
4) F.Frank Candlin : General English for Technical Students, University of London Press Ltd.

COMMUNICATION SKILLS LABORATORY

Objective :

On completion of this laboratory the candidate should be able to demonstrate adequate skills in oral and written communication for technical English language, actively participate in group discussions and interviews and exhibit the evidence of vocabulary building. Candidates should be assessed through continuous monitoring and evaluation.

The sample list of experiments is given below. This list can be used as guideline for problem statements but the scope of the laboratory should not be limited to the same. Aim of the list is to inform about minimum expected outcomes.

1. Assignments and tests for vocabulary building
2. Technical report writing
3. Group discussions
4. Interview techniques
5. Projects and tasks such as class news letter

6. Writing daily diaries and letters
7. Interactive language laboratory experiments.

TEXT BOOK : Norman Lewis : Word Power Made Easy

http://www.teachingenglish.org.uk

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SIXTH SEMESTER

6SPP1 CHEMICAL ENGINEERING OPERATION-II

(MASS TRANSFER)

SECTION-A

Unit-I Introduction to mass transfer : Various industrialy important mass transfer operations, their classification. Fundamental of mass transfer, flux, driving force, resistance, rate of mass transfer, co-current, cross current, counter current operations, Batch and continuous operations.

DIFFUSION : Molecular diffusion, Fick's law, equimolecular counter current diffusion, unicomponent diffusion in stagnant medium : stefen's law, Predication of diffusivities based on physical properties, Experimental determination of gas diffusirities winklemanns experiment. Liquid diffusivities. Gas diffusion through polymers, factors affecting gas permeability of polymers.

Unit-II Interphase mass transfer : Concept of equilibrium curves, mechanism of mass transfer. Two film theory and penetration theory. Mass transfer coefficient, relation between individual and over all mass transfer coefficient. conceptof controlling film resistance. Studies in turbulent mass transfer, dimensionless groups such as sherwood No., schimdt No., stanton no., grashoffno, JD factor.

Unit-III Flow through packed bed limiting flow rates, loading and flooding, fluidisedbed, principle of gas absorption, absorption factor, stripping factor material balance in absorption column. Equipments for gas absorption, scrubbers.

SECTION-B

Unit-IV Distillation - Vapour liquid equilibria, Raoult's laws, & VHenry's law, relative volatility, Types of distillation. Differential distillation, Rayleigh's equation, flash distillation,

Description of fractionating column, Mac'b Thele method for calculating number of plates, Effects of reflux ratio on number of plates, fenske's equation, murphree plate efficiency and overall effeciency. Introduction of Azeotropic and steam distillation. (Detailed design for azeotropic and steam disltilation is not expected)

Unit-VI Humidification and Drying : Basic definitions, psychometric chart, theory of humidification, equipments for humidification, cooling tower. Theory of drying, rate of drying, equipments for batch and continuous drying.

PRACTICALS LIST

INDEX

S.N. PRACTICAL/NAME OF EXPERIMENT

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1. To calculate diffusivity of vapours of volatile liquid into air by stefan's tube.
2. To determine the liquid diffusion of salt diffusing in water.
3. To compare the mass transfer coefficent for different liquids from free surface.
4. To prepare the b.p. diagram and plot x-y data on equilibrium diagram.
5. To determine gas film mass transfer coefficinet by wetted ball conlumn for g/l system.
6. To find mass transfer coefficient of napthalene balls in air.
7. Verification of rayleigh's equation for different (batch) distrillation.
8. To determine vapourisation efficiency and thermal efficiency in case of steam distillation.
9. To determine ceriticle moisture content of a given material.
10. To determine gas permeability of plastic film.

ANY OTHER EXPERIMENT BASED ON ABOVE SYLLABUS.

BOOKS RECOMMENDED :

1. Unit Operation of Chemical Engg. : McCabe and Smith
2. Chemical Engineering Vol. 1 : Coulson and Richardson.

3. Principles of Unit Operation : A.S.Foust.

4. Unit Operation : C.G.Brown

5. Introduction to Chemical Engineering : Badger and Banchero.

6. Mass Transfer Operation : R.E.Trebal.

7. Momentum Transfer Operation : S.K.Gupta

8. Physical Chemistry of Polymers : A. Tager.

9. Fundamentals of Polymer : Anil Kumar and R.K.Gupta.

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6 SPP 2 POLYMER ENGINEERING THERMODYNAMICS

SECTION-A

Unit I : Review of Fundamental Concepts : System, surrounding, boundary, thermodynamic processes, thermodyanmic functions and variables.

Extensive and intensive properties, Definitions and properties of state function. Concepts of enthalpy and free energy. Coefficient of thermal expansion α, compressibility coefficient β, relation between α and β. Relation between Cp and Cv.

Brief definitions of First, Second and Third law of Thermodynamics.

State of equilibrium, Free energy functions and their properties. Variation of free energy with pressure at constant temperature, temperature dependance of free energy. Thermodynamic equilibria and free energy functions, criteria for equilibria at constant T and V, Criteria for equilibria at constant T and P.

Unit II : One Component System : Physical equilibria involving phase transitions, the Clapeyron equation, application of Clapeyron equation, The Clasius - Clapeyron equation.

System of Variable Composition : Partial molar quantities, determination of partial molar quantities, Gibbs-Duhem equation, Chemical potential, Chemical potential and other thermodynamic functions, effect of temperature and pressure on chemical potential of a pure substance, chemical potential in an ideal gas mixture.

Unit III : Thermodynamic functions of mixing : Free energy of mixing, entropy of mixing, volume of mixing, enthalpy of mixing.

Properties of Liquid solutions : Ideal solutions and Raoult's law. Vapour-Liquid equilibria, Boiling point diagram and T-x-y diagram. Chemical potential in an ideal liquid solution, mixing properties of ideal solution, solubility behaviour of ideal solution.

Colligative properties : Lowering of vapour pressure, elevation of boiling point, freezing point depression, Osmosis and osmotic pressure, Determination of molecular weight of non volatile solute, Ebulliometric constant.

SECTION-B

Unit IV & Unit V : Polymer - Low molecular liquid systems : &Ideal, Non-ideal, Regular solutions, True solutions of Unit Vpolymers. Dissolution and swelling of polymers, unlimited swelling, limited swelling, factors affecting dissolution and swelling of polymers. Thermodynamics of polymer solution, Basic concepts of Flory - Huggins theory, criteria for polymer solubility, solubility parameter, Phase equilibrium of polymer - solvent system, Binary systems, LCST, UCST. Gels of polymers.

Unit VI : Chemical Equilibria

Formulation of equilibrium law, equilibrium law for ideal gases, Free energy change in chemical reaction, chemical affinity and thermodynamic functions, Equilibrium constant, Relation between Kp, Kc and Kx. Variation of equilibrium constant with temperature, variation of equilibrium constant with pressure.

Equilibria for condensation polymerisation, Equilibria of radical polymerisation.

LIST OF BOOKS :

1) An Introduction to Chemical Thermodynamics - Rastogi & Mishra, Vikas Pub.

2) An Introduction to Chemical Engg. Thermodynamics - J.M.Smith & H.C.Vanhess, Kogakusha, 1976.

3) The Principle of Chemical Equilibria and Applications in Chemistry and Chemical Engg. - K.Denbig, Cambridge Uni. Press, ELBS.

4) Fundamentals of Polymer Science and Engineering : Anilkumar and S.K.Gupta.

5) Text Book of Polymer Science : Billimeyar.

6) Physical Chemistry of Polymer : A.Tager, Mir Pub.

7) Polymer Chemistry : An Introduction : Seymour.

8) Polymer Science & Tech. of Plastics & Rubbers : P.Ghosh.

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6 SCECT 3 INSTRUMENTATION & CONTROL

SECTION-A

Unit I : Measuring Instruments : Qualities of measurement, elements of instrument, static & dynamic characteristics, measurements of temperature and levels.

Unit II : Measurement of pressure, vacuum, humidity & pH in process industry.

Unit III : Methods for composition analysis. Principle and techniques of instruments for composition analysis in process industry, such as chromatography, spectroscopy, refractrometry etc.

SECTION-B

Unit IV : Flow measuring instruments : Flow measuring devices for incompressible and compressible fluids. Electro-hydraulic valves, hydraulic servomotors, electro-pneumatic valves. Pneumatic actuators.

Unit V : Introduction to Simple system analysis : Laplace Transformation. Block diagrams, linearization. First and higher order system.

Unit VI : Frequency response, distributed parameter system, dead time.

Feed back control, servo and regulator control. Time domain closed loop responses, closed loop frequency response.

BOOKS RECOMMENDED :

1) Industrial Instrumentation : Eckman, Wiley Eastern
2) Instrumental Methods of Chemical Analysis : Erwing, McGraw Hill.
3) Instrumentation & Process Measurements : W.Bottom, Orient Longman.
4) Industrial Control & Instrumentation : W.Bottom, Orient Longman.
5) Outlines of Chemical Instrumentation & Process Control : A. Suryanarayan, Khanna Pub., New Delhi.

6) Donald R. Cougha Nowr : Process Systems Analysis and Control, McGraw Hill Pub., New York.
7) Vyas R.P. : Process Control and Instrumentation, Central Techno Pub., Nagpur.
8) Patranabis D. : Principles of Industrial Instrumentation, 2nd ed., Tata McGraw Hill Pub. Co., New Delhi.
9) Patranabis D. : Principles of Process Control, Tata McGraw Hill Pub. Co., New Delhi.
10) Gaikwad R.W., Misal S.A. : Process Dynamics & Control, Central Techno Pub., Nagpur.
11) Stephanopoulos G. : Chemical Process Control and Introduction to Theory & Practice, PHI, 1984.
12) Considine D.N. : Process Instrumentation & Control Handbook, McGraw Hill.

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6 SPP 4 ELASTOMER TECHNOLOGY

SECTION-A

Unit I : Polymers for surface coating applications, Water soluble polymers and its applications.

Unit II : Basic raw material, manufacturing, compounding and vulcanization of Natural rubber. Polysulfides, butyl rubber, SBR, Nitrile rubber & EPDM. Processing of Elastomer for pneumatic tyre and tube, its design aspects & consideration retreading of tyres.

Recent advances in Rubber Technology.

Unit III : Natural and modified natural polymers such as cellulose, cellulose nitrate. Cellulose Acetate. CAB polymers their manufacture, properties & applications.

SECTION-A

Unit IV : Additives in plastics & its requirements, types of filler and reinforcement, choice of fillers and properties. Theory of plasticizers. Types and requirement of plasticizers. Selection and properties of lubricants.

Unit V : Selection and properties of other additives such as Antioxidant Antiozonates. Antistatic agents. UV stabilizers. Antiblocking agent, Processing aids, colourants, Foaming agents, Toughning agents and Flame retardants.

Unit VI : Introduction to Adhesives, its classification & requirements. Formulation and application of adhesives in various fields, Manufacture and testing of adhesives.

Recent advances in adhesive technology.

PRACTICALS : Based on above syllabus.

BOOKS RECOMMENDED :

1) Plastics Materials : H.A.Brydson
2) Rubber Technology & Mfg. : C.M.Blow
3) Science and Technology of Rubber : E.R.Eircich
4) Introduction to Rubber Technology : Morris Morton
5) Polymer Processes : Schidknechi
6) Rubber Materials & their Compounds : Brydson
7) Plastics Additives, An Introduction Guide : Flick
8) PVC Technology : Titow
9) H.B. of Plastics & Elastomers : Harper
10) Plastics Additives Handbook IIIrd Edn. : Gachter
11) Adhesive Technology Handbook : Landrock
12) H.B. of Adhesives : Skiest
13) Fundamental of Adhesion : Lee

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6 SCECT 5 COMPUTER PROGRAMMING AND APPLICATIONS

Note : Application of the following techniques for problems of interest in chemical engineering, writing and testing of programs written in C Language.

SECTION-A

Unit I : Numerical solution of first order differential equations with initial condition, Euler's method, Runge-Kutta method.

Unit II : Systems of linear equations, solution by the method of determinants, matrix inversion for the solution of linear equations, Gauss elimination method.

Unit III : Roots of algebric and transcendental equation, iteration methods, Regula-Falsi method, Newton-Raphson method, roots of simultaneous and solution set of transcendental and algebric equations. Development of equations for heat transfer, fluid mechanics and reaction engineering problems.

SECTION-B

Unit IV : Regression analysis - Least Square, error approach, approximation by Chebychev orthogonal polynomial.

Unit V : Elements of optimization techniques, single variable function, optimization-direct search, with and without acceleration, method of regular intervals and fibonacci search method, gradient methods.

Unit VI : Computer programming in modular form, use of subroutine libraries, Block diagrams of preliminary aids in programming, capacity optimization.

PRACTICALS : Based on above theory.

TEXT BOOK : Digital Computation for Chemical Engineering by Leon Lapidas, McGraw Hill, 1962.

6 SCECT 6 MINI PROJECT

Students are required to prepare and submit report on mini project on Software Development / Market Survey / Design / Fabrication / Site Visit / Some Experimental Investigation / Validation in the relevant field under the guidence of teacher.

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SEVENTH SEMESTER

7SPP1 POLYMER REACTION ENGINEERING.

SECTION-A

Review of Chemical kinetics : rate of reaction, order of reaction rate constant, Effect of tempp. on rate constant.

Unit-I Classification of Polymerization reactions & reactors.

Isothermal/Nonisothermal, constant volume/variable volume, single ideal reactor, Ideal batch and steady state flow Ideal reactors such as plug flow and constant flow strred tank reactors. Material balance and energy balance across these ideal reactors. Performance/design equations for ideal reactors.

Unit-II TECHNIQUES OF POLYMERIZATION : Bulk, Solution, Suspension, emulsion and Dispersion Polymerization, gas phase olefin polymerization.

Unit-III Kinetics of emulsion polymerization, Smith Ewart theory for stage II Polymerisation, estimation of total number of Polymer particles, Kinetics of Dispersion polymerisation, Fitch Theory.

Merits and demerits of different techniques of polymerisation.

SECTION-B

Unit-IV Reaction Engineering of condensation polymerisation - Kinetics of A-R-B type condensation polymerisation, Average molecular weight in consensation Polymerisation : Effect of

stoichiometric ratio of functional group on degree of Polymerisation, Molecular weight distribution in condensation Polymerisation : equation for number average chain length and weight average chain length. Choice of reactor in condensation Polymerisation regarding average molecular weight and molecular weight distribution. Control of molecular weight.

Unit-V Reaction Engineering of radical Polymerisation - Kinetic model of radical polymerisation, Average molecular weight in radical polymerisation. Determination of rate of Polymerisation and rate constant by dilatometer, molecular weight distribution in radical Polymerisation : equation for number average chain length and weight average chain length. Choice of reactor in radical Polymerisation regarding average molecular weight and molecular weight distribution. Control of molecular weight in radical Polymerisation by different methods such as increase in the temperature of Polymerisation, method of weak inhibition, use of chain transfer agents.

Unit-VI Introduction of non-ideal reactor : Basic idea of R.T.D. studies. Constructional features of large Polymerisation reactors : For suspension technique : polymerisation of Polystyrene and Polyvinyl chloride.

Agitation, heating-cooling, cleaning arrangements in large polymerisation reactors.

PRACTICALS : List of Experiment enclosed any other experiment based on above syllabus.

BOOKS RECOMMENDED :

1. Fundamental of Polymer Science & Engineering Anilkumar & S.K.Gupta.
2. Polymerisation Reactors & Process : J.N.Henderson.
3. Polymerisation Kinetics & Technology : Naj Platzer
4. Polymer Reaction Engineering (2318) : Reicharl
5. Chemical Reaction Engineering : O Levenspiel.

LIST OF EXPERIMENTS

1. To study kinetics of reaction by differential/integral method of analysis.

2. To find activation energy and frequency factor.
3. Performance of batch reactor.
4. Performance of C.S.T.R.
5. Performance of tubular reactor.
6. Bulk Polymerisation technique.
7. Emulsion Polymerisation technique.
8. Suspension Polymerisation technique.
9. R.T.D.Studies in m ixed vessel.
10. R.T.D.Studies in tubular flow.
11. To study kinetics of Polycondensation.
12. To study kinetics of Addition Polymerisation by dilatometer.

Any other experiment based on above syllabus.

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7 SPP 2 STRUCTURE PROPERTY RELATIONSHIP IN POLYMER

SECTION-A

Unit I : Classification of polymer - on the basis of structure, regularity, chemical constitution, configuration and conformation of chain. Freely jointed chain :- segment of chain, size & shape of macromolecular chain, random flight model, random flight end to end distance. Internal rotation in macromolecule : internal rotation in freely jointed chain, the forces affecting internal rotation - different types of intra molecular / inter molecular interactions. Flexibility of chain : thermodynamic and kinetic flexibility of chain, factors affecting flexibility, practical importance of chain flexibility.

Unit II : Supermolecular structure : Molecular aggregation & stable state of assemblage, two phase structure in solid polymer, fringed micelle theory, structure of amorphous polymer, structural features of crystallizable polymers, degree of crystallinity and measurement of degree of crystallinity.

Unit III : Thermodynamics of crystallization and melting : Energetics of phase change, equilibrium melting temperature and its determination, mechanism of crystallization, Kinetics of crystallization, Avrami's equation, experimental studies of kinetics of crystallization in polymers, general kinetic features of crystallization.

SECTION-B

Unit IV : Morphology of crystallline polymers :- Polymer single crystal, folding of chain, lamellae. Structure of polymer crystallized from melt - spherullite. Extended chain crytal, strain induced morphology - fibrilar crystals, defect structre of crystalline polymer. Morphological changes during orientation. Structure formation during processing.

Unit V : Polymer structure and physical properties :

(a) The crystalline Melting Point :- Melting point of homologous series, effect of chain felxibility and other steric factors, side chain substitution, effect of co-polymerization.

(b) The Glass Transition Temperature :- Effect of molecular weight, effect of chemical structure, effect of chain topology, branching, and cross linking on glass transition.

(c) Mechanical Properties :- Effect of crystallinity, molecular weight, cross link density, and filler on mechanical strength of glassy and crystalline polymers. Mechanical strength and life time of polymer.

(d) Electrical Properties :- Electrical properties of polymers such as dielectric break down strength, dielectric loss, permitivity. Effect of chemical constitution of polymer, stero regularity and crystallinity of polymer on electrical properties.

Unit VI : (a) Property requirement and polymer utilization for different applications such as Elastomers, Fibers, General purpose plastics, optical applications, electrical applications, Mechanical applications.

(b) Special applications of polymers and their structures : Liquid crystalline polymers, polymer sorbents and porous structure of polymer, ion exchange resins.

BOOKS RECOMMENDED :

1. The Structure of Polymers - M.L.Miller, Reinhold Pub. Corporation, New York.
2. Physical Chemistry of Polymers - A. Tager, MIR Pub., Moscow.
3. Properties and Structure of Polymers - Arthur V. Tobolsky, John Wiley and Sons Inc. Pub.

4. Polymer Structure Properties and Applications - R.D.Deanin, Calmer Pub. Co., New York, 1972.
5. Properties of Polymers - D.W.Van Krevelin and P.J.Noftyier, Elsever S. Pub. Co., Amsterdam, 1976.
6. Polymer Materials Science - J. Schultz, Prentice Hall Inc., N. 1974.
7. Physical Methods in Macromolecular Chemistry -

7SPP3 POLYMER PROCESSING-I

SECTION-A

Unit-I & II Injection moulding Principle, process, Types of injection moulding m/c, Clamping unit, injection unit selection of injection moulding machines, materials used. M/c maintainance, defects and remedies. Feed system in injection moulding, Quality in injection molding.

Fundamental of injection moulding, typical injection moulding cycle, effect of materials, properties and precess variables on product quality, Runneress and hot runner moulding.

Injection moulding of thermosets. Problems of calculation of optimum no. of cavities, Injection pressure, volumetric output, HP/KW required, Wall thickness, Shrinkage etc.

Recent developments in injection molding such as Gas assist injection molding, two colour injection moulding.

Unit-III Compression Moulding

Principle, Process, types of process, materials used properties of materials relevant to moulding process. Compression moulding cycle, equipments and auxillary equipments,Interrelation between flow properties of the polymers, process parameters as well as moulding design on product quality. Different types of compression moulds.

Molding defects and remedies.

SECTION-B

Unit-IV Transfer Moulding

Principle,process discription, Transfer moulding cycle. Types of process, materials used. Types of equipment camparision with compression moulding, limitations, Defects and remedies.

Unit-V Lamination, casting, foaming of polymers, rotational molding and reaction injections moulding.

Unit-VI Recycling Tech : Types of recycling, size and material seperation, biodegradation, incineration.

LIST OF PRACTICALS

1. To study the working of intensive dry mixture during preparation of P V C compound.
2. To manufacture shoe sole compound using extruder.
3. To study the effect of processing parameters during preparation of Bottle cap by hand injection process.
4. Selection of injection moulding machine.
5. To manufacture Test sample using reciprocating screw injection moulding machine by various materials (LDPE, HDPE and P S)
6. Using heat Gun. (Shrink-Pack Techniques)
7. To study the rotational moulding machine and to prepare sample.
8. To manufacture two way electric plug using Transfer moulding machine.
9. To study the laboratory extruder.
10. Calculate the water absorption of filler percent in P V C sheet.
11. Production of articles by compression moulding and effect of process parameters on moulded articles.
12. To study the hydraulics and electric circuits of automatic injection molding m/c.

Any other experiment based on above syllabus.

BOOKS RECOMMENDED :

1) Injection Molding, Theory and Practice : I.I.Rubin
2) Injection Molding Design, IInd Edn., : R.C.W.Pye.
3) Plastic Molding Engg. : D.A.Dearle.
4) Principles of Polymer Processing : Z.Tadmor and C.G.Goges.
5) Injection Molding of Machine : Whelan
6) S.P.I.H.B. of Plastic Engg. : Fraders.
7) Reaction Injection molding (3033) : Reichart.
8) Injection molding Hand Book (3881) : Athalye.
9) Polymer Processing (5686) : Mortan Jones.
10) Plastic Molding Techniques (1902)

11) Plastic Engg. : Crawford.
12) Basic Principles of Rotational molding : Bonins.
13) Molding of Thermosetting Plastics : Whealan.
14) Injection Molding Hand Book : Rosato.
15) Manual by Klockneer and Windsor on Injection Molding.
16) Recycling of Plastics by Adab and Chandra.
17) Plastics Molding Plant, Vol. II : M.G.Munns.
18) Vickers H.B. on Hydraulics.

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7SPP4 POLYMER BLENDS AND COMPOSITES

SECTION-A

Unit-I Polymer Blends-Miscible and Imscible type, compatibilization mechanism, compatibilizes used in polymer blends and their addition method, compatibility of polymer blends, criteria for compatibility, methods of blends preparation, such as mechanical graft, block and IPNS, Principle tests for polymer compatibility.

Unit-II Transition behaviours to polyblends. Impact modification by elastomers, types of impact modifiers, characteristics of impact modifiers, Effect of blend type and rubber content on impact strength of polymer blend. Bulk behaviour of two phase polymer material. Toughening mechanism in elastomer modified blend.

Unit-III Preparation, properties, Uses and processing of commercial polyblends - Incompatible, semicompatitle or compatible type eg. rubber - rubber polyblends, synthetic paper polyblends, HIPS, Blends based on PPO, PE, PVC, ABS, EVA,EPDM and PU-arylic, etc.

SECTION-B

Unit-IV Polymer composite, classification of composites, Fundamentals of polymer composites systems such as matrix, Reinforement/fibre and Reinforcement-matrix interphase, their role in polymer composite. Types of composites - mechanical, Thermal, Viscoelastic properties of composites in relation to processing.

Unit-V Application of composites in different fields-Automobile, Aerospace, Marine, Land transportation. Electrical and Electronics, Construction and industry.

Unit-VI Reinforced plastics types, material for reinforcement, type of matrix and additives. Processing techniques of reinforced plastics & application. (open & close molding, pultrusion)

PRACTICALS : Based on above syllabus.

BOOKS RECOMMENDED :

1. Polymer Blends D.R.Paul and S.Newman Academic Press. New York 1976.
2. Polymer Blends and Alloys-Byutraki
3. Polymer Engg. Composites, M.O.W.R.Richardson applied science London 1976.
4. Polymer Blends and Alloys By M.J.Folkes and P.S. Hope Blackie Academic and Professional Publication.
5. Handbook of Fillers and Reinforcement for Plastics, H.S.Katz and J.V.Milweski, Van Nostrand Renhold Renhold Co.New York 1978
6. SPI Handbook of Tech. and Engg. of Reinforcements for Plastics and Composites, J.G.Mohr.S.S.Oleesky, G.D.Shook, L.S.Meyer, Van Nostrand Renhold Co., New York 1973.
7. Structural Design with Plastics, B.S.Benjamin, Van Nostrand Renhold Co. New York, 1982.
8. Polymer Composite by Margolies.

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7SCEPP5 PLANT DESIGN AND PROJECT ENGINEERING

SECTION A

Unit I : Basic considerations in Chemical Engineering Plant Design. Project identification, preliminary teachno-economic feasibility. Process design aspects-process selection, factors affecting. Importance of laboratory development, pilot plant, scale-up methods, safety factors, flow diagrams.

Unit II : Selection of process equipments-standard Vs special equipments, materials of construction of process equipment, selection Criteria, specification sheets.

Process auxiliaries - piping design, layout, process control and instrumentation.

Process utilities-process water, boilerfeed water, waste treatment & disposal, Oil heating system, chilling plant, compressed air v accum.

Unit III : Plant location and layout principles, factors affecting, use of scale methods, case studies.

SECTION B

Unit IV : Cost estimation-factors involved in project cost estimation, total capital investment, fixed capital and working capital, Methods of estimation of investment. Cost index and scaling for equipment cost. Estimation of total product cost-factors involved. Interest-types & calculations.

Unit V : Depareciation-types & methods of determination. Profitability - alternative investment and replacement methods, practical factors in alternative & replacement investment.

Unit VI : Inventory control, scheduling a project using CPM/PERT. Project management. Optimum conditions-optimum production rates in plant operations, optimum conditions in cyclic operations. Design reports.

BOOKS RECOMMENDED :

1. Plant design and Economics for Chemical Engineers - Max S.Peters & Klaus D. Timmerhaus, Fourth Edition, McGraw Hill (1991).
2. Chemical Engineering Plant Design - F.C.Vibrandt & C.E.Dryden, McGraw Hill (1954)
3. Dryden C.E., Viradant T.C. : Chemical Engg. Plant Design, McGraw Hill.
4. Timmerhaus and Klaus D. : Plant Design and Economics for Chemical Engineers, 4th ed., 1991.

Note : Industrial visits and case studies are expected.

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EIGHT SEMESTER

8SPP1 POLYMER PROCESSING-II

SECTION-A

Unit I Extrusion & II Principles of extrusion, Design features of extruders such as type of drives, types of screws, L/D ratios, compression ratio, pitch, screen, breakers plate, barrels, heating and temperature controls. Mechanism of extrusion zones of extruder.

M/c & equipments for the production of pipes, profiles, blown and cast film, tapes, wire coating etc. Behaviour of various Polymers in extrusion, effect of material properties and process parameter on product quality, trouble shooting M/C maintanance. Twin screw extruder, co-extrusion and vented extruders.

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

*ORDINANCE NO. 6 OF 2001.

Examinations leading to the Degree of (तांत्रिकी स्नातक) Bachelor of Technology (Four Year Degree Course...Semester Pattern) Ordinance, 2001.

Whereas, it is expedient to provide an Ordinance in respect of Examinations leading to the Degree of (तांत्रिकी स्नातक) Bachelor of Technology (Four Year Degree Course...Semester Pattern) for the purposes hereinafter appearing the Management Council is hereby please to make the following Ordinance.

1. This Ordinance may be called Ordinance in respect of Examinations leading to the Degree of (तांत्रिकी स्नातक) Bachelor of Technology (Four year Degree Course — Semester pattern) Ordinance, 2001.

2. This Ordinance shall come into force from the date of its approval by the Management Council.

3. Subject to the conditions prescribed by the Government from time to time, for admission to First B.Tech.(Chemical Technology) course the candidate shall be considered eligible:

   Passing 12th Standard Examination of the new pattern means the 12th Standard Examination of the Maharashtra State Board of Secondary and Higher Secondary Education with subject:

   1. English (Higher or Lower)
   2. Modern Indian Language (Higher or Lower)
   3. Mathematics and Statistics.
   4. Chemistry
   5. Physics
   6. Any other optional subject from out of the list prescribed by the said Secondary and Higher Secondary Education Board.

   OR

   1. English (HIgher or Lower)
   2. Mathematics and Statistics.
   3. Chemistry
   4. Physics
   5. Vocational subject (Defined by the said Board as a Technical Subject)

* As amended by Ordinance Nos. 27 of 2001, 7 of 2003 & 4 of 2005.

OR

An Examination recognised by the Amravati University as an equivalent to the above.

4. Subject to the conditions prescribed by the Govt. from time to time for direct admission to the Second B.Tech., (Chemical Technology) the candidate shall be considered eligible:

   Passing Diploma in respective branch in First Division, awarded by the Board of Technical Examination of Maharashtra State, Mumbai.

   OR

   Any Diploma equivalent to the corresponding Diploma of the Board of Technical Examinations of Maharashtra State, Mumbai.

5. The Degree of Bachelor of Technology (Chemical Technology) shall be awarded to examinee who, in accordance with the provisions of this Ordinance, qualifies, himself/herself for the award in any of the following branches of Technology with specialization in :-

   i. Polymer (Plastic)

   ii. Food

   iii. Pulp & Paper

   iv. Oil & Paint

   v. Petrochemical

6. (i) There shall be Eight Semester Pattern Examinations leading to the Degree of Bachelor of Technology (Chemical Technology) (First, Second, Third, Fourth, Fifth, Sixth, Seventh & Eight Semester B.Tech.)

   (ii) For the purposes of instructions and examinations the student shall study sequentially.

   (iii) The first & Second Semester Examinations shall be common for all the branches.

7. The period of Academic Session shall be such as may be notified by the University.

8. The main examination of first, third, fifth and seventh semester B.Tech. shall be held by the University in winter & supplementary examination in summer every year. And main examination of second, fourth, sixth & eighth semester B.Tech. will be held in summer & the supplementary examination in winter every year.

9. The Internal Assessment marks for theory should be based on Class Test and Attendance as follows :-

a)	Class Test	-	15 Marks will be based upon two Class Tests.
b)	Attendance	-	Marks
	75% to 80%	-	1
	81% to 85%	-	2
	86% to 90%	-	3
	91% to 95%	-	4
	96% to 100%	-	5

Where ever if internal assessment marks are 'ten (10)' then it should be converted out of "20".

10. Subject to his/her compliance with the provisions of this Ordinance and other Ordinance (pertaining to Examinations) in force from time to time, the applicant for admission, at the end of the course of study of a particular semester, to an Examination specified in Column (1) of the table below, shall be eligible to appear if,

(i) He/she satisfies the conditions in the table and the provisions thereunder.

(ii) he/she complies with the provisions of the Ordinance pertaining to the Examinations in general from time to time.

(iii) he/she has prosecuted a regular course of study in a College affiliated to the University.

(iv) he/she has, in the opinion of the Principal, shown satisfactory progress in his/her studies.

TABLE

Name of Exam	The student should have passed the Exam. of	The Student should have satisfactorily completed the following session/ semester	The student should have passed following examination.
First Semester B.Tech.	XII standard Examination or equivalent	.....	.....
Second Semester B.Tech.	.....	I Semester B.Tech.	.....
Third Semester B.Tech.	.....	II Semester B.Tech.	2/3rd heads of I & II Sem. combined together
Fourth Semester B.Tech.	.....	III Semester B.Tech.	- do -
Fifth Semester B.Tech.	I & II Sem. B.Tech.	IV Semester B.Tech.	2/3rd heads of III & IV Sem. combined together
Sixth Semester B.Tech.	- do -	V Semester B.Tech.	- do -
Seventh Semester B.Tech.	III & IV Sem. B.Tech.	VI Semester B.Tech.	2/3rd heads of V & VI Sem. combined together
Eight Semester B.Tech.	- do -	VII Semester	- do - B.Tech.

11. An Examination who has passed 2/3rd heads of passing shall be allowed to keep term in the next higher class.

Explanation :

i) While calculating 2/3rd heads of passing, fraction, if any, shall be ignored.

ii) For Considering the heads of passing, every theory and every practical, shall be considered as separate head of passing.

12. The schemes of Examinations shall be as prescribed by the Regulation.

13. The fees for each B.Tech. Examination (Theory & Practical) shall be as prescribed by University from time to time.

14. An examinee who is successful at any of the Ist, IInd, IIIrd, IVth, Vth, VIth, VIIth, and VIIIth Semesters B.Tech. Examinations under this Ordinance and who obtains 75% or more marks in that examination shall be placed in the First Division with distinction, those securing less than 75% but getting 60% or more shall be placed in the First Division and all other successful examinees shall be placed in the Second Division. However the division for the award of degree shall be based on VII and VIII Semester examinations marks taken together.

15. (i) The scope of the subjects shall be as indicated in the syllabi.

(ii) The medium of instruction and Examination shall be English.

16. The provision of the Ordinance No.7-A shall apply to the Examination under this Ordinance.

17. An examinee who does not pass; or who fails to present him/herself for the examination shall be eligible for readmission to the same examination/Semester, on payment of fresh fees and such other fees as may be prescribed.

18. A candidate who could not complete a semester satisfactorily or who has failed will be eligible for readmission to the same semester. However readmission to semester should be allowed only when a regular session is running for the perticular semester.

19. One who has passed the Final B.Tech. examination of the University in one branch and who desirous of taking B.Tech. degree in another branch shall be admitted to the Third Semester of that branch and shall be governed by this Ordinance for all other purposes.

20. As soon as possible after examinations, the Board of Examinations shall publish a result of the examinees. The result of all examination shall be classified as stated in para 14 & 15 above

and the branchwise merit list shall be notified as per Ordinance No. 6.

21. Nothwithstanding anything to the contrary in this Ordinance no one shall be admitted to an examinations under this Ordinance, if he/she has already passed the same examinations or an equivalent examinations of any statutory University.

22. (i) The examinees who have passed in all the subjects prescribed for all the examinations of the particular branch shall be eligible for award of the Degree of Bachelor of Technology in the branch concerned.

(ii) The degree in the prescribed form, shall be signed by the Vice-Chancellor.

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* REGULATION NO. 8 OF 2001.

Examinations leading to the Degree of Bachelor of Technology [Polymer (Plastic)] (Four Year Degree Course....Semester Pattern) Regulation, 2001.

Whereas it is expedient to frame the Regulation in respect of Examinations leading to the Degree of Bachelor of Technology [Polymer (Plastic)] (Four Year Degree Course.... Semester Pattern) for the purposes hereinafter appearing the Management Council is hereby pleased to make a following Regulation.

1. This regulation may be called "Examinations leading to the Degree of Bachelor of Technology [Polymer (Plastic)] (Four Year Degree Course....Semester Pattern) Regulation, 2001.

2. This Regulation shall come into force from the date of its approval by the Management Council.

3. The Schemes of Teachings and Examinations for IIIrd & IVth, Vth & VIth, and VIIth & VIIIth Semester for Bachelor of Technology [Polymer (Plastic)] (Four Year Degree Course....Semester Pattern) shall be as per Appendices B, C, and D appended with this Regulation, respectively.

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* As amended vide Regulation Nos. 37 of 2003 and 45 of 2007.

APPENDIX-B

L : Theory Lecture
T : Tutorial
P : Practical
D : Drawing/Design work

FOUR YEAR B.TECH. (CHEM.TECH.) DEGREE COURSE
POLYMER (PLASTIC) TECHNOLOGY
SEMESTER PATTERN
THIRD SEMESTER

ABBREVIATIONS
S - SEMESTER PATTERN
CE - CHEMICAL ENGINEERING
CT- Chemical Technology including Food/Pulp & Paper/Oil & Paint/ Petrochemical and Polymer (Plastic)

Sr. No.	Sub. Code No.	SUBJECT	:TEACHING SCHEME: L:	T:	P/D	Total Hours/ week	EXAMINATION SCHEME Theory Duration of papers (Hrs.)	Max. Marks Theory papers	Max. Marks College Assess-ment	TOTAL	Min pass Marks	Practical Max Marks	Max. Marks College Assess-ment.	TOTAL	Min pass Marks	Grand Total
1.	3SCT1	Electrical Technology	4	1	2	7	3	80	20	100	40	25	25	50	25	
2.	3SCECT2	Applied Physical Chemistry-II	3	1	2	6	3	80	20	100	40	25	25	50	25	
3.	3SCECT3	Strength of Material	3	1	2	6	3	80	20	100	40	25	25	50	25	
4.	3SCECT4	Applied Thermodynamics	3	1	2	6	3	80	20	100	40	25	25	50	25	
5.	3SCECT5	Process Calculations	3	1	-	4	3	80	20	100	40	-	-	-	-	
		TOTAL	16	05	8	29				500				200		700

FOURTH SEMESTER

Sr. No.	Sub. Code No.	SUBJECT	:TEACHING SCHEME: L:	T:	P/D	Total Hours/ week	EXAMINATION SCHEME Theory Duration of papers (Hrs.)	Max. Marks Theory papers	Max. Marks College Assess-ment	TOTAL	Min pass Marks	Practical Max Marks	Max. Marks College Assess-ment.	TOTAL	Min pass Marks	Grand Total
1.	4SCT1	Applied Mathematics-II	4	1	-	5	3	80	20	100	40	-	-	-	-	
2.	4SPP2	Polymer Chemistry-I	3	1	2	6	3	80	20	100	40	25	25	50	25	
3.	4SCECT3	Machine Design & Drawing	2	1	2	5	3	80	20	100	40	25	25	50	25	
4.	4SCECT4	Material Technology	3	1	2	6	3	80	20	100	40	25	25	50	25	
5.	4SPP5	Momentum Transfer Operation	3	1	2	6	3	80	20	100	40	25	25	50	25	
		TOTAL	15	05	8	28				500				200		700

APPENDIX-C

L : Theory Lecture
T : Tutorial
P : Practical
D : Drawing / Design

FOUR YEAR B.TECH. DEGREE COURSE
POLYMER (PLASTIC) TECHNOLOGY
SEMESTER PATTERN
FIFTH SEMESTER

ABBRIVATIONS :-
S - SEMESTER PATTERN
Pp - POLYMER (PLASTIC)
CE - CHEMICAL ENGG.
CT - Chemical Technology including Food/Pulp & Paper/Oil & Paint/ Petrochemical and Polymer (Plastic)

Sr. No.	Sub. Code No.	SUBJECT	Teaching Scheme L	T	P/D	Total Hours/ Week (Hrs)	Examination Scheme: Theory Duration of Papers	Maximum Marks Theory Papers	College Assessment	Total	Min. Pass Marks	Practical Maximum Marks External	Internal	Total Marks	Mininum Passing Marks
1.	5SCECT1	Heat Transfer	4	1	2	7	3	80	20	100	40	25	25	50	25
2.	5SPp2	Chemical Engineering Operation-I (Mechanical Opertion)	4	1	2	7	3	80	20	100	40	25	25	50	25
3.	5SPp3	Polymer Chemistry-II	4	1	2	7	3	80	20	100	40	25	25	50	25
4.	5SPp4	Polymer Materials	3	1	2	6	3	80	20	100	40	25	25	50	25
5.	5SCECT5	Economics & Management	3	-	-	3	3	80	20	100	40	--	--	--	--
6.	5SRNCECT6	Communication Skills	2	1	-	3	2	40	10	50	20	15	10	25	12
		TOTAL	20	05	8	33				550				225	

GRAND TOTAL : 775

L : Theory Lecture
T : Tutorial
P : Practical
D : Drawing / Design

FOUR YEAR B.TECH. DEGREE COURSE
POLYMER (PLASTIC) TECHNOLOGY
SEMESTER PATTERN
SIXTH SEMESTER

ABBRIVATIONS :-
S - SEMESTER PATTERN
Pp - POLYMER (PLASTIC)
CE - CHEMICAL ENGG.
CT - Chemical Technology including Food/Pulp & Paper/Oil & Paint/ Petrochemical and Polymer (Plastic)

Sr. No.	Sub. Code No.	SUBJECT	Teaching Scheme L	T	P/D	Total Hours/ Week (Hrs)	Examination Scheme: Theory Duration of Papers	Maximum Marks Theory Papers	College Assessment	Total	Min. Pass Marks	Practical Maximum Marks External	Internal	Total Marks	Mininum Passing Marks
1.	6SPp1	Chemical Engineering Operation-II (Mass Transfer)	4	-	3	7	3	80	20	100	40	25	25	50	25
2.	6SPp2	Polymer Engineering Thermodynamics	4	-	-	4	3	80	20	100	40	--	--	--	--
3.	6SCECT3	Instrumentation and Control	4	1	2	7	3	80	20	100	40	25	25	50	25
4.	6SPp4	Elastomer Technology	4	-	2	6	3	80	20	100	40	25	25	50	25
5.	6SCECT5	Computer Programming and Application	3	1	2	6	3	80	20	100	40	25	25	50	25
6.	6SCECT6	Mini Project	-	-	2	2	-	--	--	---	--	25	25	50	25
		TOTAL	19	02	9	30				500				250	

GRAND TOTAL : 750

APPENDIX-D

L : Theory Lecture
T : Tutorial
P : Practical
D : Drawing / Design

FOUR YEAR B.TECH. DEGREE COURSE
POLYMER (PLASTIC) TECHNOLOGY
SEMESTER PATTERN
SEVENTH SEMESTER

ABBRIVATIONS :-
S - SEMESTER PATTERN
Pp - POLYMER (PLASTIC)
CE - CHEMICAL ENGG.

Sr. No.	Sub. Code No.	SUBJECT	Teaching Scheme L	T	P/D	Total Hours/ Week (Hrs)	Examination Scheme: Theory: Duration of Papers	Maximum Marks: Theory Papers	College Assessment	Total	Min. Pass Marks	Practical: Maximum Marks: External	Internal	Total Marks	Mininum Passing Marks
1.	7SPp1	Polymer Reaction Engineering	4	-	2	6	3	80	20	100	40	25	25	50	25
2.	7SPp2	Structure Property Relationship in Polymer	4	-	-	4	3	80	20	100	40	--	--	--	--
3.	7SPp3	Polymer Processing -I	4	-	3	7	3	80	20	100	40	25	25	50	25
4.	7SPp4	Polymer Blends and Composite	4	1	2	7	3	80	20	100	40	25	25	50	25
5.	7SCEPp5	Plant Design and Project Engineering	3	1	-	4	3	80	20	100	40	--	--	--	--
6.	8SPp5	Project and Seminar	-	-	2	2	-	--	--	---	--	--	--	--	--
		TOTAL	19	02	9	30	15			500				150	

GRAND TOTAL : 650

L : Theory Lecture
T : Tutorial
P : Practical
D : Drawing / Design

FOUR YEAR B.TECH. DEGREE COURSE
POLYMER (PLASTIC) TECHNOLOGY
SEMESTER PATTERN
EIGHTH SEMESTER

ABBRIVATIONS :-
S - SEMESTER PATTERN
Pp - POLYMER (PLASTIC)

Sr. No.	Sub. Code No.	SUBJECT	Teaching Scheme L	T	P/D	Total Hours/ Week (Hrs)	Examination Scheme: Theory: Duration of Papers	Maximum Marks: Theory Papers	College Assessment	Total	Min. Pass Marks	Practical: Maximum Marks: External	Internal	Total Marks	Mininum Passing Marks
1.	8SPp1	Polymer Processing-II	4	-	3	7	3	80	20	100	40	25	25	50	25
2.	8SPp2	Mould Design for Plastic	3	-	2	5	4	80	20	100	40	--	--	--	--
3.	8SPp3	Polymer Viscoelasticity and Rheology	4	1	-	5	3	80	20	100	40	--	--	--	--
4.	8SPp4	Elective *	4	1	2	7	3	80	20	100	40	25	25	50	25
5.	8SPp5	Project and Seminar	-	-	6	6	3	(1)	College Assessment:-						
									(i) Project				50		
									(ii) Seminar				25	150	75
								(2)	University Oral Exam.				75		
		TOTAL	15	02	13	30				400				250	

GRAND TOTAL : 650

8 SPP 4 Elective *1) Testing and Product Design 2) Surface Coating Technology 3) Decorative Plastics.

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI
*** ORDINANCE NO. 42 OF 2005**

Examination in Environmental Studies leading to Bachelor Degree, Ordinance, 2005

Whereas it is expedient to frame an Ordinance relating to Examination in Environmental Studies leading to Bachelor Degree level, hereinafter appearing, the Management Council is hereby pleased to make the following Ordinance.

1. This Ordinance may be called "Examination in Environmental Studies leading to Bachelor Degree, Ordinance, 2005."

2. This Ordinance shall come into force from the Academic session 2005-06.

3. In this Ordinance and in other ordinances relating to the examination, unless there is anything repugnant in the subject or context :-

   (i) "Academic session" means a session commencing on such date and ending with such date of the year following as may be appointed by the Management Council.
   (ii) "Admission to an examination" means the issuance of an admission card to a candidate in token of his having complied with all the conditions laid down in the relevant ordinance, by a competant officer of the University.
   (iii) "Applicant" means a person who has submitted an application to the University in the form prescribed for admission to an examination.
   (iv) "Candidate" means a person who has been admitted to an examination by the University.
   (v) "Regular Candidate" means an applicant who has applied for admission to a Univeristy examination through an affiliated college, Department or Institute in which he/she has prosecuting a regular course of study.
   (vi) "Examinee" means a person who present himself/herself for an examination to which he/she has been admitted.
   (vii) "Examination" means an examination prescribed by the University under the relevant Ordinance.
   (viii) "External Candidate" means a candidate who is allowed to take a University examination in accordance with the provision of Original Ordinance No. 151.
   (ix) " Non-Collegiate Candidate" means a candidate who is not a collegiate candidate.

* As amended vide Ordinance Nos. 7 of 2006 & 10 of 2007.

   (x) An "Ex-student" is a person who having once been admitted to an examination of this University, is again required to take the same examination by reason of his failure or absence thereat and shall include a student who may have joined a college, Department or Institute again in the same class.
   (xi) "Bachelor Degree Examination" means a examination leading to Bachelor Degree of the University.
   (xii) "Previous Year" means a year following by final year of Bachelor Degree.

4. Save as otherwise specifically provided, the conditions prescribed for admission to the examination under this Ordinance shall apply to all persons who wish to take the examination to the Degrees of the University mentioned in para 5 below.

5. The conditions prescribed for admission to examination under this Ordinance shall apply to following degrees of the University :-
   1) Bachelor of Arts
   2) Bachelor of Performing Arts
   3) Bachelor of Fine Arts
   4) Bachelor of Mass Communication
   5) Bachelor of Social Work
   6) Bachelor of Commerce
   7) Bachelor of Business Administration
   8) Bachelor of Science
   9) Bachelor of Computer Science
   10) Bachelor of Computer Applications
   11) Bachelor of Pharmacy
   12) Bachelor of Science (Home Science)
   13) Bachelor of Technology (Cosmetics)
   14) Bachelor of Engineering
   15) Bachelor of Engineering (Part Time) (Civil)
   16) Bachelor of Textile
   17) Bachelor of Technology (Chemical Technology)
   18) Bachelor of Technology (Chemical Engg.)
   19) Bachelor of Architecture, and
   20) Bachelor of Laws (Five Year Course)

6 i) Environmental Studies shall be a compulsory subject for a previous year examination of the following Bachelor Degrees of the University,
   1) Bachelor of Arts
   2) Bachelor of Performing Arts
   3) Bachelor of Fine Arts
   4) Bachelor of Mass Communication

5) Bachelor of Social Work
6) Bachelor of Commerce
7) Bachelor of Business Administration
8) Bachelor of Science
9) Bachelor of Computer Science
10) Bachelor of Computer Applications
11) Bachelor of Pharmacy
12) Bachelor of Science (Home Science)
13) Bachelor of Technology (Cosmetics)
14) Bachelor of Engineering (Part Time) (Civil)

ii) Environmental Studies shall be a compulsory subject for IIIrd & IVth Semester of the following Bachelor Degrees of the University,
1) Bachelor of Engineering
2) Bachelor of Textile
3) Bachelor of Technology (Chemical Technology)
4) Bachelor of Technology (Chemical Engineering)
5) Bachelor of Architecture, and

iii) Environmental Studies shall be a compulsory subject for Vth & VIth Semester of the Degree of Bachelor of Laws (Five Year Course)

iv) Students admitted to Second Year/Third Year/IVth Semester/ VIth Semester of various degree examination courses in different Faculties in the academic session 2005-06 or thereafter shall have to appear for examination in the subject Environmental Studies.

7. The main examination leading to Environmental Studies shall be held in Summer and supplementary examination in Winter every year, at such places and on such dates as may be appointed by Board of Examinations.
Explanation:- Examination shall be conducted on the basis of one common question paper for all Bachelor Degree Examination courses irrespective of annual or semester pattern.

8. Scope of the subject for annual pattern examination and or semester pattern examination shall be as provided under the syllabus.

9. Common question paper for all courses covered under this Ordinance alongwith answer books shall be supplied by the University to the Colleges, Departments and Institutes for conducting the examination of the subject.

10. Valuation of the answer books relating to this subject shall be done at College/Department/Institution level only. Remuneration for valuation of answer books shall not be paid by the University.

Provided that prescribed evaluation fee for evaluation of each answer book/s of an external examinee/s appeared from the examination centre shall be paid to each examination centre.

11. It shall be obligatory on the part of the College/Department/Institute to submit candidate wise following information to the University on or before the date as may be prescribed by the University :-

Sr. No.	Grade/Category	Marks secured
1.	"A"	- 60 and above
2.	"B"	- 45 to 59
3.	"C"	- 35 to 44
4.	"D"	- 25 to 34
5.	"Fail"	- 24 and below
6.	"Absent"	

12. For the purposes of teaching, learing and examination, the Committee consisting of three teachers shall be appointed by the Principal/ Head of the Department/Head of the Institution under his/her Chairmanship/ Chairpersonship. While appointing three teachers on the said committee, the Principal shall take care that the teachers to be appointed on the committee, if necessary, shall be from different faculty.

13. i) Duration of theory examination of this subject shall be three hour.
ii) For all Bachelor Degree examinations, common question paper of 100 marks shall be provided by the University.
iii) Distribution of these 100 marks shall be as follows :-
a) Part-A, Short Answer Pattern - 25 Marks
b) Part-B, Essay type with inbuilt choice - 50 Marks
c) Part-C, Essay on Field Work - 25 Marks

14. Medium of instruction shall be English or Marathi or Hindi. Question paper shall be supplied in English and Marathi and Hindi. A candidate shall have option to write answers in English or Marathi or Hindi.

15. Examination for the subject Environmental Studies shall be compulsory for external candidates appearing as a fresh candidate at Winter and/or summer examination.

16. For teaching of the subject, there shall be atleast two hour per week. For teaching the subject to the regular candidates, a full time approved teacher of the University and or a person having Postgraduate Degree in any faculty with second class shall be considered elligible.

17. For teaching of the subject, additional fee to be charged to regular candidate shall be as prescribed by the University.

18. Every College/ University Teaching Department shall charge additional fee of Rs. 100/- to every Student of the subject Environmental studies. Out of this Rs. 100/-, the College/University Teaching Department shall have to pay Rs. 25/- to the University as an examination fee of each candidate for the subject environmental studies.

19. The Grade secured by an examinee in the examination of this subject shall not be considered for providing the facility of A.T.K.T. in next higher class.

20. The provisions of Ordinance No. 18/2001 shall not be applicable for securing a grade or higher grade in the examination of this subject.

21. Result of the Final Year of the respective Degree shall not be declared of an examinee unless he/she secures any one of the grade in the examination of subject.

Provided an examinee admitted to Five Year LL.B. course desiring not to continue his/her education beyond Sixth Semester of the said course shall have to secure any one of the grade in the examination of the subject otherwise his/her result of Sixth Semester for awarding B.A. degree shall not be declared.

22. Certificate shall be issued, to the successful examinees in the subject Environmental Studies, after the examination.

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Unit-III Blow Molding

Principle, types of B.M., salient features of injection and extrusion B.M., Blow molding cycle, choice of material for blow molding. Comparision between extrusion and injection blow molding. Stretch blow molding, Principle and advantage. Wall thickness control, Parision programming and it's methods, Trouble shooting.

SECTION-B

Unit-IV Calendering:

Principle and process description, types of calender units 2, 3 and 4 rolled calenders, Design of calender roll, Heating and temp control, roll crown, roll crossing and roll bending, materials for calendering, calendering sheets and films, embossing, coating and lamination by calender, comparision between calendering and extrusion.

Unit-V Finishing techniques solvent cementing, electroplating, Hot stamping, vacuum metallizing, Heat sealing, welding, scree printing, Lecuring.

Unit-VI Vacuum Forming

Process description, Diff. Techniques of vacuum forming, equipments used in vacuum forming, advantages and limitations and comparision of vacuum forming with injection molding.

Spinning : Process fundamentals, melt spinning, solution and wet spinning of fibres, Drawing and orientation, effects of unfolding, crystallinity and orientation on quality of spinning fibres.

LIST OF PRACTICALS

1. Study and constructionof single screw extruders.
2. Manufacturing of Pipes/Pellets.
3. Manufacturing of Blown film.
4. Manufacturing of woven sack
5. Manufacturing of strands. (Granules Reprocessing)
6. Manufacturing of extrusion blow molded articles.
7. Manufacturing of articles by vacuum forming

8. Study of calender unit
9. Screen Printing process for plastics
10. To prepare solvent cement for plastics
11. To calculate the mixing index of PVC
12. To study the characterties of shrink packaging.

Any other experiment based on above syllabus.

REFERENCE BOOKS

1. Extrusion of Plastics by E.G.Fisher, Newness Butterworth, London.
2. Polymer Extrusion by Rouwendari, Hanser Publication.
3. Extrusion of Plastics by - Finner
4. Dies, for Plastics Extrusion by M.V.Joshi
5. H.B. of Blow Molding by Rosato, Hanser Publication.
6. Plastics Extrusion Technology by Hensen.
7. Extrusion of Plastics-Klockner Windsor Publication.
8. SPI H.B. of Plastics Engg. by Benger.
9. Twin Screw Extruders by Martell.
10. PVC Technology by Athalye.
11. Decorating Plastics by Margolis.
12. Fundamentals of Fibre Formation by A.Ziabecki
13. Thermoforming by Throne.
14. Polymer Processing by Morton.
15. Extrusion Technology by Griff.
16. Blow Molding of Plastics - Fisher.

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8SPP2 MOULD DESIGN FOR PLASTICS

SECTION-A

Unit-I Choice of materials for mould making, different types of steels and steel alloy used in mould making, composition and its propertice. Methods of heat treatment and advantages.

Properties of aluminium, berryilium, copper and zinc used for moulds. Selection of materials for specific mould components, Different machine tools and methods used in mould making like grinding, milling, and die sinking machines, casting hobbing and polishing operation. Electro-discharge machining. Electrolytic depositing process.

Unit-II & III

Injection mould

Classification of Injection moulds. Design of runners, gates, vents and sprue. Design of Ejection systems. Different techniques of Ejection. Design of cooling systems, cooling of cavity and core, cooling channels, bubbler, baffic and helical channel.

Hot runner moulds - Design consideration, its advantages and limitation. Mould economics - Determination of No. of cavities and cost estimate, Runnerless Moulds, Different types nozzles for mould. Parting line, cavity and core location, use of core and inserts, locating ring and sprue bushing. Moulds for articles with Drafts and Undercuts, Allowance for shrinkage and warpage problems. Design of

Heating systems - Electrical heating, Resistance, Capacitance and inductance heating, types of heaters, and temperature control.

BLOW MOULDS : Design of simple blow moulds, Die design for parison control.

SECTION-B

Unit IV

EXTRUSION DIE

Design aspects of the following extrusion dies - Pipe Die, sheet Die, Monofilament Die, Blown film and cast film die, Tape Die, Profile Die.

Contol of flow properties and heater design, Aspects of design of specific componants such as bearing, gears etc.

Unit-V

Compression Mould

Flash, positive, semipositive moulds. Detailes of cavity block, punch plate, guidepins, pressure pads, cores etc. standard components of compression mould typical design.

Unit-VI

Transfer Mould

Design of integral pot and auxillary ram types. Design of standard mould part like transfer pot, transfer plungers, sprue bush. Transfer pressure and clamping force.

TERM WORK (DRAWING)

Every student has to complete five sheets based on the following mould designs.

1. Compression Mould 1 sheet
2. Transfer Mould 1 sheet
3. Injection Mould 3 sheets.

Books recommended

1. Plastics Mould Engineering - Dubois J.H.
2. Plastics Product Design Handbook - Miller
3. Plastic Product Design - Beck R.D.
4. Injection Molds and Molding - Dym
5. Dies for Plastics Extrusion - M.V.Joshi
6. Injection Mold Design 4th Edn. - Pye
7. Mold Making H.B. - Stoechhart
8. Design of Plastics Molds and Dies - Sors
9. Injection Mold Design, Design Mannual for Thermoplastic Industry (1567)
10. Designing with Plastics and Composities - Rosato.

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8SPP3 POLYMER VISCO ELASTICITY AND RHEOLOGY

SECTION-A

Unit-I

State of Aggregation and phase states of matter Molecular motion in Polymers, Transition relaxation processess in Polymers.

Unit-II

Glass Transition, Theories to determine the glass transition i.e. Dillatometric, Heat capacity, measurement, Thermomechanical, Measurement of modulus of elesticity, effect of Tg on molecular mass, kinetic chain flexbility and chemical constituent, Importance of Tg and Tm, HDT.

Unit-III

Viscoelastic behavior of Polymer solution and melts stress-strain curves for Polymers, creep of Polymeric material, elastic deformation, irrecoverable follow deformation. Rubber like deformation, Time-temp superposition (WLF Equation) Models of viscollastity such as Maxwell and kelvin model. Types of viscosity, stress relaxation.

SECTION-B

Unit-IV Introduction and Basic concept of Rheology, classification of fluids, newtonian and non newtonion fluids, sheaqr stress, shear strain and shear rate, shear modullus, bulk modulos, Zero shear viscosity, Dependance of viscosity with temp, shear stress, shear rate fluid through channel, characteristic parameter during shear deformation.

Unit-V Methods to determine shear viscocity by capillary Rheometer, cone and plate viscometer, Cup and bob viscometer, Measurement of normal stresses. Theories of viscocities of dilute (De-bye Bueche theory) and conc. Solutions (Grasselley's entanglement theory), (Entanglement concern)

Unit-VI Rheology of dilute and concentrated supensions, effect of Rheology during Injection, moulding Extusion: Film extrustion, sheet Extrusion and Blow mouldings of polymers.

Rheometer, Bubble inflation rheometer, compressional rheometers, stress relaxation instruments. Torque rheometers, rotational & sliding surface rheometers and their use in determining processability.

BOOK RECOMMENDED

1. The Flow of Highpolymers, S. Middleman John Wiley and Sons, George St. 1968.
2. Rheometry K.Walters, Chapman and Hall London 1975
3. Rheology of Polymers :G.V.Vinogradov and A.Ya Malkin Mir Pub MOSCOW 1980.
4. J.J. Alkonis and W.J.Macknight - Introduction to Polymer Viscoelasticity - Willey Inter Science, New York-1982.
5. Viscoelasticity of Polymers D.D.Ferry III Edn. John Willey and Sons New York 1981.
6. Physical Chemistry of Polymers - Tager.
7. Polymer Sc. and Tech. of Plastics and Rubber ; D.Ghosh.
8. Melt Rheology and its Role in Plastics Processing : Dealy
9. Flow Properties of Polymer Melt by J.A.Brydson.

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8SPP4 ELECTIVE

1) TESTING AND PRODUCT DESIGN

SECTION-A

Unit-I Introduction - concepts of strength of Polymers, theoritical stress analysis, theory and types of fracture, comparison between metals and polymers. selection of polymer on strength & stiffness basis.

Unit-II & VI Principles tests for mechanical properties such as tension, shear, compression, flexural, hardness. Impact strength such as : pendulum, Izode, charpy, chip, Falling weight : Dart impact, high speed impact tester, abrasion creep :- such as tensile creep, flexural creep, stress relaxation. Electrical properties such as dielectric strength, dielectric constant, dissipation factor, arc resistance & electric resistance.

Unit-III Testing of Polymers for thermal, optical, Environmental & Weathering Properties, Chemical Properties and other properties, such as nondistructive testing.

SECTION-B

Unit-IV Importance of polymer material, material and process selection for designing of product, aspect of temperature, elasticity, flame resistance, impact strength, moisture, chemical wear, Permeability, weathering, odour and taste.

Unit-V Processing parameter on structure, properties and quality of the product. Aspect of parting line, wall thickness, Ribs and bosses, molded holes, inserts, Threads, mold/dies, gates, runners, parting lines and their design aspects. Mouldability general considerations, and specific cases.

BOOKS RECOMMENDED

1. Identification and Testing of Plastics by Athalye.
2. Product Design with Plastics by Dym.
3. Designing with Plastics by E.H.Renstein.
4. Plastics Product Design H.B.Part A and B by Miller.
5. Plastics Product Design by R.D.Beck.
6. Plastics Engg. by Croford.
7. Product Design and Testing of Polymeric Material by Che Reminishroff.

8. H.B. of Plastics Testing Technologyby V.Shah.
9. H.B. of Plastic Test Methods Vol-I and II by Brown
10. Designing with Plastics and Composites by Rosato.
11. Quality Control and Testing Manual of Copet.
12. Plastics Product Design H.B.by Levy.
13. Mechanical Prop. and Polymers by Norbert M.Bikates.

PRACTICALS :

Based on above syllabus.

8SPP4 ELECTIVE

2) SURFACE COATING TECHNOLOGY

i) Coating : 02H (05M)

Introduction, surface tension and wetability, contact angles and spreading, coating methods, selection of coating methods, application of coating.

ii) Roll Coating : 07H(10M)

Introduction, classification, roll coating methods such as forward roll coating, reverse roll coating, deformable roll, gravure roll, defects and remedies.

iii) Premetered Coating : 05H(08M)

Introduction, extrusion coaters, slide or cascade coaters, curtain coaters, instabilities in slide coating.

iv) Air Knife Coating : 05H(08M)

Introduction, typical operation range, mechanism, coating thickness correlation, defects and remedies.

v) Adhesives : 05H(08M)

Interfacial contact, surface tension, wetting equilibria, kinetics of wetting bonding operation.

vi) Mechanism of Adhesion : 05H(08M)

Introduction, mechanical inter locking, diffusion theory, adsorption theory, (no mathematical treatment, only application for adhesion and principle only)

vii) Surface Pretretment : 03H(06M)

Introduction, low energy surface, high energy surface.

viii) Classification of Adhesives : 07H(08M)

Introduction, types, hardening by solvent or dispersing medium, hardening by coo; cooling, hardening by chemical reaction, non hardening adhesives.

ix) Mechanical behavior of adhesives joint : 06H(08M)

Common joint design, single lap joint, double lap joint, modified lap joint, peel joint, flexible joint, rigid joint.

x) Test methods for Joints : 03H(06M)

Service life of adhesive joints, fatique, environmental attak.

PRACTICALS :

Based on above syllabus.

8SPP4 ELECTIVE

3) DECORATIVE PLASTICS

SECTION-A

Unit I : Painting on plastic : Introduction, developing a plastic paint plan, selecting and qualifying a paint, modification of plastic part, surface preparing, applying aresole paints to plastic paint, developing paint film on plastic part, inspecting the painted plastic part quality, selective painting of plastic part, applying multiple paint films together, testing and quality of paints on plastic. 08H

Unit II : Plating on plastic : Introduction, conductive plastics electroless copper or nickel plating, electroplating, high throw acid copper strikes, straight through vs. semi bulk electroplating, microprocesses chrome plating, decorative electroplated finishes, plating on plastics, platable plastics. 08H

Unit III : Coating on plastic : Thermal spray coaring on plastic key process, flame spraying, arc spray, plasma, wide variety of metals, adhesion, surface preparation, priming the surface with sprayed zinc, final coating fishing the spray coating, seeling the surface. 08H

SECTION-B

Unit IV : Vacuum metalizing : metallizing equipment, metallizing process details, general process out line, function and application.

Hot stamping : Introduction, foils, tooling and dies silicone

dies, hot stamping machines, vertical presses, roll on, linear contact machines, hot stamping process and application. 06H

Unit V : Printing on plastics : Surface treatment, printing techniques, equipment and application of screen printing, flexography, inmold decoration, flocking embossing and surface texturing. 08H

Unit VI : Machining, joining and assembling of plastics : Machining plastics : Introduction, drilling and reaming, tapping and threading, turning and milling, sawing etc.

Adhesive bondling of plastics : techniques, joints, solvent cementing of thermoplastics, cementing of thermosetting plastics, welding of plastics, dielectric heat sealing, thermal sealing, hot gas welding, hot plate welding, mechanical joints, mechanical fastness. 08H

PRACTICALS :

Based on above syllabus.

List of Text and Reference Book :

1) Decorating Plastics by Margolis.

2) SPI H.B. of Plastics Engineering by m.Bertins.

8 SPP 5 PROJECT AND SEMINAR

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SANT GADGE BABA AMRAVATI UNIVERSITY.

SPECIAL NOTE FOR INFORMATION OF THE STUDENTS

(1) Notwithstanding anything to the contrary, it is notified for general information and guidance of all concerned that a person, who has passed the qualifying examination and is eligible for admission only to the corresponding next higher examination as an ex-student or an external candidate, shall be examined in accordance with the syllabus of such next higher examination in force at the time of such examination in such subjects papers or combination of papers in which students from University Departments or Colleges are to be examined by the University.

(2) Be it known to all the students desirous to take examination/s for which this prospectus has been prescribed should, if found necessary for any other information regarding examinations etc., refer the University Ordinances Booklet the various conditions/provisions pertaining to examination as prescribed in the following Ordinances.

Ordinance No. 1	:	Enrolment of Students.
Ordinance No. 2	:	Admission of Students
Ordinance No. 4	:	National cadet corps
Ordinance No. 6	:	Examinations in General (relevent extracts)
Ordinance No. 18/2001	:	An Ordinance to provide grace marks for passing in a Head of passing and Inprovement of Division (Higher Class) and getting Distinction in the subject and condonation of defficiency of marks in a subject in all the faculties prescribed by the Statute, No.18, Ordinance, 2001.
Ordinance No. 9	:	Conduct of Examinations (relevent extracts)
Ordinance No. 10	:	Providing for Exemptions and Compartments
Ordinance No. 19	:	Admission of Candidates to Degrees.

Ordinance No. 109	:	Recording of a change of name of a University student in the records of the University.
Ordinance No. 6/2008	:	For improvement of Division/Grade.
Ordinance No.19/2001	:	An Ordinance for Central Assessment Programme, Scheme of Evaluation and Moderation of answerbooks and preparation of results of the examinations, conducted by the University, Ordinance 2001.

Dineshkumar Joshi
Registrar
Sant Gadge Baba
Amravati University.

PATTERN OF QUESTION PAPER ON THE UNIT SYSTEM

The pattern of question paper as per unit system will be broadly based on the following pattern.

(1) Syllabus has been divided into units equal to the number of question to be answered in the paper. On each unit there will be a question either a long answer type or a short answer type.

(2) Number of question will be in accordance with the unit prescribed in the syllabi for each paper i.e. there will be one question on each unit.

(3) For every question long answer type or short answer type there will be an alternative choice from the same unit. However, there will be no internal choice in a question.

(4) Division of marks between long answer and short answer type question will be in the ratio of 40 and 60.

(5) Each short answer type question shall Contain 4 to 8 short sub question with no internal choice.