FOURTH SEMESTER

MAU202 MATHEMATICS IV

(Prerequisite : MAU 101 , MAU 102)

L	T	P	Cr.
3	1	0	3

Module 1 (11L + 4T)

Series solutions and special functions - power series solutions of differential equations, theory of power series method, Legendre equation, Legendre polynomial, Frobenius method, Bessel's equation, Bessel functions of the second kind, Sturm-Liouville's problems, orthogonal Eigen function expansions.

Module 2 (12L + 4T)

Partial differential equations - basic concepts, Cauchy's problem for first order equations, linear equations of the first order, nonlinear partial differential equations of the first order, Charpit's method, special types of first order equations, classification of second order partial differential equations, Modeling - vibrating string, wave equation, separation of variables, use of Fourier series, D'Alembert's solution of the wave equation, heat equation: solution by Fourier series, heat equaton: solution by Fourier Integrals and transforms, Laplace equation, solution of a partial differential equation by Laplace transforms.

Module 3 (10L + 3T)

Complex functions, derivative, analytic function, Cauchy - Reimann equations, Laplace's equation, geometry of analytic functions - conformal mapping, linear fractional transformations, Schwarz - Christoffel transformation, transformation by other functions.

Module 4 (9L + 3T)

Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, derivatives of analytic functions, power series, functions given by power series, Taylor series and Maclaurin's series. Laurent's series, singularities and Zeros, Residue integration method, evaluation of real integrals.

TEXT BOOK

Kreyszig, E., Advanced Engineering Mathematics, 8th Edn, John Wiley & Sons, New York, 1999.

REFERENCE BOOKS

1. Sneddon, I.N., Elements of Partial Differential Equations, Dover Publications, 2006.
2. Wylie, C.R. & Barret, L.C., Advanced Engineering Mathematics, 6th Edn., Mc Graw Hill, New York, 1995.
3. Donald W Trim, Applied Partial Differential Equations, PWS- KENT Publishing Company, 1994.

CHU211 CHEMICAL TECHNOLOGY I

(Prerequisite : Nil)

L	T	P	Cr.
3	0	0	3

Module 1 (9 hours)

Chemical processing and work of the chemical engineer - basic chemical data, batch and continuous processing, flow charts, chemical process selection, design and operation, chemical process control and instrumentation, chemical process economics, market evaluation, plant locations, safety, hazards such as fire or toxic materials, chemical process selection, design and operation research and development, patents, process system engineering.

Module 2 (11 hours)

Chlor-alkali industries - manufacture of soda ash, manufacture of sodium bicarbonate, manufacture of chlorine and caustic soda, sodium chloride. Sulphur and sulphuric acid - **m**ining and manufacture of sulfur, manufacture of sulphuric acid.

Module 3 (11 hours)

Cement - types and manufacture of Portland cement. Glass - manufacture of glasses and special glasses. Ceramics - refractories. Fuel and industrial gases, manufacture of paints and pigments.

Module 4 (11 hours)

Nitrogen fertilizers - synthetic ammonia, nitric acid, urea, ammonium chloride, CAN, ammonium sulphate. Phosphorous fertilizers - phosphate rock, phosphoric acid, super phosphate and triple super phosphate, MAP, DAP. Potassium fertilizers - potassium chloride and potassium sulphate.

TEXT BOOKS

1. George T Austin, Shreve's Chemical Process Industries- International Student Edition, 5th Edn.., Mc Graw Hill Inc., 1985.
2. Gopal Rao, R. and Sittig, M., Dryden's Outlines of Chemical Technology, 3rd Edn., Affiliated East-West Publishers,1997.

REFERENCE BOOK

Shukla, S.D. and Pandey, G.N., Text book of Chemical Technology, Vol.I, 1977.

CHU212 MATERIAL SCIENCE

(Prerequisite : Nil)

L	T	P	Cr.
3	0	0	3

Module 1 (10 hours)

Classes of engineering materials, engineering requirement of materials, selection of materials, structure of atoms and molecules, bonding in solids - types of bonds and comparison of bonds. Structure and imperfections in crystals - crystal structure, crystal geometry, structure of solids, methods of determining structures, imperfection in crystals, types of imperfection, point imperfection

Module 2 (9 hours)

Phase diagrams and transformations - phase rule, single and binary phase diagrams, micro structural changes during cooling, iron and iron carbide phase diagrams, zone refining

Module 3 (11 hours)

Elastic and plastic deformation in the materials - elastic behaviour, rubber elasticity, visco-elastic behaviour, stress-strain curves, plastic deformation by slip, shear strength of real and perfect crystals, multiplication of dislocations, creep, ductile and brittle behaviour, Griffth's criterion, fatigue. Corrosion- theories of corrosion, control and prevention of corrosion

Module 4 (12hours)

Thermal, electrical, optical and magnetic properties- solar cells, superconductors, polarization, frequency and temperature dependence of dielectric constant, piezo and ferroelectricity, optical absorption, optoelectronic materials. Ferri and ferromagnetism, soft and hard magnetic materials (Fe-Si, Fe-Ni alloys, Al-Ni-Co alloy and ceramic magnets).

TEXT BOOKS

1. Raghavan V., Material Science and Engineering Prentice Hall of India, New Delhi, 1996.
2. Van Vlack M., Materials Science for Engineers, Addison Welsey Publishing Company, UK, 1980.
3. Hajra Choudhary, S.K., Material Science and Processes, 2nd Edn., Indian Book Distributing Co., Calcutta, 1982.

REFERENCE BOOKS

1. Rose M. Shepard, John Wulff, The Structure and Properties of Materials, Vol.4 (Electronic properties), Wiley, Singapore, 1984.
2. Adrianus J. Dekker, Electrical Engineering materials, Prentice Hall of India, New Delhi, 1992.
3. Anderson, J.C., Keith D. Leaver, Rees D. Rawlings, Patrick S. Leevers, Materials Science for Engineers, 5th Edn., Nelson Thornes Ltd., UK, 2003.

CHU213 MECHANICAL OPERATIONS

(Prerequisite : Nil)

L	T	P	Cr.
3	0	0	3

Module 1 (11 hours)

Properties and handling of particulate solids - characterisation of solid particles, standard screen series, mixed particle size and screen analysis, calculation based on screen analysis. Properties of particulate masses, pressure in masses of particles. Size reduction - principles of comminution, particle size distribution in comminuted products, energy and power requirements in comminution, Rittinger's law, Kick's law, Bond's crushing law and work index, size reduction equipment, crushers, grinders, ultrafine grinders (jaw crusher, gyratory crusher, smooth roll crusher, roller mills, attrition mills, revolving mills, fluid energy mills), equipment operation

Module 2 (12 hours)

Mechanical separations - screening, comparison of ideal and actual screens, capacity and effectiveness of screens, filtration, principles of cake filtration, pressure drop through filter cake, filter medium resistance, constant pressure filtration, constant rate filtration, continuous filtration, filter aids, washing of filter cakes, equipment of liquid-solid filtration, principles of centrifugal filtration, separations based on the motion of particles through fluids, gravity settling processes, batch sedimentation, differential settling methods, centrifugal settling processes, cyclone separation, centrifugal decanters, principles of centrifugal sedimentation

Module 3 (10 hours)

Agitation and mixing of liquids - introduction, agitation equipment, axial and radial flow impellers and flow patterns in agitated vessels, power consumption in agitated vessels, blending and mixing: mixing of solids and paste, types of mixers. Magnetic separation, electrostatic separation, jigging, heavy media separation, froth floatation process, additives used in floatation, floatation cells, flocculation, briquetting, pelletization and granulation.

Module 4 (9 hours)

Storage and conveying of solids - bins, hoppers and silos, flow out of bins, design consideration of bins, loading and unloading of solids, bucket elevators, apron conveyors, belt conveyors- types of belt conveyors, selection considerations

TEXT BOOKS

1. McCabe, W.L. and Smith, J.C., Unit Operation of Chemical Engineering, 5th Edn., McGraw Hill, New York, 1993.
2. Coulson, J.M. and Richardson, J.F., Chemical Engineering, Vol. II, 4th Edn., Butterworth - Heinemann, 1991.

REFERENCE BOOKS

1. Raymond A. Kulweic, Materials Handling Handbook, 2nd Edn., Wiley-Interscience Publications, 1985.
2. Badger and Banchero, Introduction to Chemical Engineering, 1st Edn., McGraw Hill, NewYork, 1954.
3. Perry, R.H. and Green , W.D., Perry's Chemical Engineers' Hand Book, 7th Edn., McGraw Hill International Edn., New York, 2000.

CHU214 HEAT TRANSFER

(Prerequisite : Nil)

L	T	P	Cr.
3	0	0	3

Module 1 (10 hours)

Importance of heat transfer in chemical engineering operations, modes of heat transfer. Fourier's law of heat conduction, steady-state conduction through walls (single and multi-layers), heat flow through a cylinder and sphere, unsteady state heat conduction, heat transfer in extended surfaces.

Module 2 (12 hours)

Concepts of heat transfer by convection, counter-current and parallel flows, energy balances, overall heat transfer coefficient, log-mean temperature difference, individual heat transfer coefficient, calculation of overall heat transfer coefficients from individual coefficients, fouling factors, analogies between transfer of momentum and heat – Reynolds analogy, Prandtl and Coulburn analogy, dimensional analysis in heat transfer, heat transfer coefficient for flow through pipe, non circular conduit, flow past flat plate, flow through packed beds, heat transfer by natural convection.

Module 3 (10 hours)

Heat transfer to fluids with phase change, heat transfer from condensing vapours, drop-wise and film type condensation, Nusslet equations for film type condensation, condensation for superheated vapours, heat transfer to boiling liquids, boiling of a saturated liquid, maximum flux and critical temperature drop, minimum flux and film boiling, sub-cooled boiling, Theory of evaporation, single effect and multiple effect evaporation, design calculation for single and multiple effect evaporation.

Module 4 (10 hours)

Radiation heat transfer, emissive power, blackbody radiation, emissivity, laws of radiation, radiation between surfaces, heat transfer equipments - parallel and counter flow heat exchangers, single pass and multi-pass heat exchangers, plate heat exchangers, design of various types of heat exchangers, furnaces, condensers and tubular exchangers.

TEXT BOOKS

1. McCabe, W.L. and Smith, J.C., Unit Operation of Chemical Engineering, 6th Edn., McGraw Hill, New York, 2001.
2. Holman, J.P., Heat Transfer, 8th Edn., McGraw Hill, 1997.

REFERENCE BOOKS

1. Gupta C.P and Prakash R, Engineering Heat Transfer, Nemchand and Brothers, Roorkee, 1989.
2. Kern, D.Q., Process Heat Transfer, Mc Graw Hill Co. Inc, 1999.
3. Coulson, J.M. and Richardson, J.F., Chemical Engineering, Vol 1, 4^{th} Edn., Asian Books Pvt Ltd., India, 1998.

ECG216 APPLIED ELECTRONICS

(Prerequisite : Nil)

L	T	P	Cr.
3	0	0	3

Module 1 (10 hours)

Review of BJT characteristics, h-parameter equivalent of BJT, biasing schemes, single stage CB, CE and CC amplifiers, class A, class B and class AB power amplifiers, Wein Bridge, RC phase shift, Hartley and Colpitt's oscillators, introduction to JFET and MOSFET, characteristics

Module 2 (11 hours)

Review of op-amp and basic op-amp circuits, current to voltage and voltage to current converters, instrumentation amplifiers- log and antilog amplifiers, comparators- sine, square and triangular wave generators and mono-stable multivibrator - linear sweep circuits

Module 3 (11 hours)

Review of logic gates and combinational circuits, Flip flops, Shift registers, Counters, A/D converter (R- 2R ladder), D/A converters – dual slope and successive approximation Introduction to Microprocessors and Microcontrollers, 8051 microcontroller architecture, instruction set, assembly language programming examples

Module 4 (10 hours)

Transducers – classification & selection criteria, principles of piezoelectric, photoelectric, thermoelectric transducers- resistance temperature transducers (RTD)- thermistors, strain gauge, LVDT, application of transducers in the measurement of temperature, pressure, velocity, flow, pH, liquid level transducers

TEXT BOOKS

1. Donald A Neamen, Electronic Circuit Analysis and Design, 2nd Edn., Mc Graw Hill
2. Morris Mano, Digital Logic and Computer Design, PHI.
3. Kenneth J Ayala. The 8051 Microcontroller, Architecture, Programming and Applications, International Thompson Publishing.
4. Copper, W.D., Electronic Instrumentation & Measurement Technique, Prentice Hall of India.
5. Malvino, A.P., Electronic Principles, 3rd Edn., Tata McGraw Hill.

CHU292 CHEMICAL TECHNOLOGY LABORATORY

L	T	P	Cr.
0	0	3	2

1. Preparation of soap
2. Preparation of dyes and pigments
3. Solvent extraction of oil
4. Analysis of raw materials, intermediates and products such as
    a. Common salt
    b. Lime
    c. Urea
    d. Soda ash
    e. Alum
    f. Coal
    g. Vegetable oils
    h. Sugar
    i. Bleaching powder
5. Testing of fuels
    a. Orsat analysis
    b. Reid's vapour pressure
    c. Redwood viscometer
    d. Flash and Fire point
    e. Aniline point
    f. Photo-colorimeter
    g. Infrared moisture balance
    h. Bomb calorimeter
    i. Gas calorimeter

ECG296 ELECTRONICS LABORATORY

L	T	P	Cr.
0	0	3	2

1. Introduction to instruments
2. Study of CRO
3. Current and voltage measurements
4. Rectifiers and filters
5. RC coupled single stage BJT amplifier
6. RC phase shift oscillator
7. Study of logic gates
8. Op amp inverting, non inverting and summer
9. Sine and square wave generation using op amp
10. R-2R digital to analog converter
11. Study of analog to digital converter
12. Study of transducers