

4th Semester
Chemical Engineering

Branch: Chemical Year: Second year Semester: Fourth

Sl. No.	Course No.	Subject	Periods			Evaluation Scheme					
			L	T	P	Sessional Exam			ESE	Subject Total	Credit
						TA	CT	Total			
Theory											
1	MA 411	Advanced Maths & numerical analysis	3	1		30	20	50	100	150	4
2	HU 402	Sociology and Accountancy	3	1		30	20	50	100	150	4
3	HU 403	Communication Skills	2			15	10	25	50	75	2
4	EE 404	Electro Technology-II	3	1		30	20	50	100	150	4
5	CH 485	Process Calculations	3	1		30	20	50	100	150	4
6	CH 486	Energy Engineering	3	1		30	20	50	100	150	4
7	CH 487	Fluid Flow Operations	3	1		30	20	50	100	150	4
Practicals/Drawing/Design											
8	EE 404 L	Electro Technology-II Lab			3	30	20	50		50	2
9	CH 486L	Energy Engineering			3	30	20	50		50	2
10	CH 487L	Fluid Flow Operations			3	30	20	50		50	2
11	CH 488	General Proficiency							25	25	1
Total			20	6	9						

Total Marks: 1150

Total Periods: 35

Total Credits: 33

TA: teachers assessment

CT: Class Test

ESE: End Sem Exam

MA 411 ADVANCED MATHEMATICS AND NUMERICAL ANALYSIS

Theory – 100 marks.

Sessional – 50 marks.

Time – 3 Hours.

Unit 1: Partial differential equations: Basic concepts, Formation of partial differential equations, equation solvable by direct integration, linear and non-linear equations of first order. Homogenous linear equation with constant coefficients, solutions of heat equations, wave equations, transmission line equation and Laplace equation.

Unit 2: Calculus of Complex variables: Analytic functions, C-R equations, conjugate functions, Harmonic functions, orthogonal systems, Formation of analytic function, conformal mapping, Integration of a complex function, Cauchy's integral Theorem, Power series representation of complex functions, Laurent's Series, Singularities, Residue Theorem.

Unit 3: Numerical Analysis:

Numerical Integration: Trapezoidal Rule, Simpson's Rule, Gaussion Quadrature.

Numerical solutions of linear and non-linear algebraic equations.

Approximation of functions.

Solution of ODE, initial value problems and boundary value problems.

Numerical solution of PDE.

Finite Differential method : Newton, Bessel and Langrange's formula.

Unit 4: Optimization Methods: Introduction.

Optimization by calculus: Unconstrained function of a single variable.

Unconstrained function of a multiple variable.

Function with equality constraints.

Function with inequality constraints.

Linear Programming:

Introduction to Simplex Method.

Dual Problems.

Transportation Problems.

Examples of Computer Solution from Civil Engineering.

Text/References:

1. Advanced Engineering Maths : E. Kreyszig, Wiley Eastern Ltd.
2. Peter V O'Neil : Thomson Books.
3. R. K. Jam & S.R.K. Iyenger. : Narosa.
4. A Text Book of Engineering Maths : Bali, Saxena, Iyenger, Laxmi Publications.
5. Higher Engineering Maths : B. S. Grewal, Khanna Publications.
6. Calculus : James Stewart, Thomson Books.
7. Laplace Transform : Spiegel S. Chand & Co.
8. Elements of Partial Diffeq. : I. M. Snedon.
9. Numerical methods with Computer programs in C++, Pallab Ghosh, Prentice Hall.

HU 402 Sociology And Accountancy (3-1-0)

Part A. Sociology and Industrial Relations

Theory: 50. Sessional: 25

1. Concept of the state. Origin and Development of the State. The individual and the State.
2. Social Institutions and Social Groups. Non-governmental Organizations and Panchayati Raj Institutions; local communities and alternate social Groups-characteristics, functions and purposes;
3. Social structure. Social differentiation; Role, Status, Power and Authority; Social differentiation. Social order and social problems.
4. Social Change: Meaning and nature of social change; factors effecting social change; Technology and social change; Social and economic displacement. Labour and Labour Relations; Organised and unorganized labor; Problems associated with labour. Labour problems: absenteeism, labour turnover, displacement and obsolescence.
5. Human resources: Meaning and development; Relation with industrial and economic needs. Industrial productivity. Workers participation in Management.
6. Man Power Planning: Definition and Objectives. Characteristics of Man Power Planning. Manpower Demand and Supply forecasting.
7. Industrial disputes- settlement of Industrial disputes. Trade Unionism in India. Labour legislation in India- Indian Factories Act, 1948. Payment of Wages Act, 1936. Workmen's Compensation Act, 1923.
8. Social Security: concept of social security. Provision for Social security in India.

Recommended readings:

1. Rao, C.N. Sankara, Sociology.
2. Sarma, RN, Principles of Sociology.
3. Mukherjee, R.K, Indian Working Class.
4. Saxena, R.N, Labour Problems and Social Welfare.

Part B. Accountancy

Theory: 50. Sessional: 25

1. Dual aspect concept of Accounts, classification of Accounts, cardinal rules for Debit and Credit, Journal, Ledger, Balancing of Account.
2. Subsidiary books, types of Cashbook, Imprest, Petty cash book, Bank reconciliation statement.
3. Trial balance; Trading and Manufacturing account; Profit and Loss account; balance sheet with adjustments.
4. Concepts of Capital expenditure and Revenue expenditure; Bad debt and doubtful debt, Reserve capital and Liabilities; Outstanding expenses; Prepaid expenses, Marshalling of Balance sheet, Liquidity and Profitability of assets.
5. Cost accounting- concept, benefits and distinction between cost accounting and financial accounting- various elements of cost, cost sheet, overhead cost, Job and process costing.
6. Depreciation — concept and importance. Methods of charging depreciation on fixed assets used in industries.

Recommended readings:

1. Shukla, MC., Grewal T.S., and Gupta, SC: Advanced Accounts; S. Chand & Co. New Delhi.
2. Agarwala A. N. Agarwala K. N~ Higher Sciences of Accountancy: Kitab Mahal Allahabad.
3. Rajpurohit R. S., Bissa, and others: Financial Accounting.
4. Cost Accounts- M.C. Shukla.

HU 403 Communication skills (2-0-0)

Theory: 50

Sessional:25

Time: 1 ½ Hours

- 1) Group Discussion: aspects; preparation; facing group discussions
- 2) Communication- Aspects, Issues and Vitals.
- 3) Body Language – Studying body language; its orientation
- 4) The art of listening: Active listening; hearing and listening; good listening;
Barriers to listening.
- 5) Negotiation- The act of negotiation. Truths about negotiation; hurdles in negotiation.

RECOMMENDED BOOKS:

1. Essentials of Business Communication : Pal and Rorualling; Sultan Chand and Sons.
2. The Essence of Effective Communication: Ludlow and Panthon; PHI.
3. A Practical English Grammar by Thomson and Marlinet
4. Spoken English by V Sasikumar and PV Dhamija; Tata McGraw Hill
5. English Conversation Practice by Grount Taylor; Tata McGraw Hill
6. Developing Communication Skills by Krishna Mohan and Meera Banerji:
MacMillan India Ltd., Delhi

EE 404: ELECRO-TECHNOLOGY-II (ME & CHE)

(3 – 1 – 2)

Theory Marks:100

Sessional Marks: 50

Laboratory Marks : 50

Time = 3 hours

1. Analog Electronics:

Bi-polar transistor (BJT) – PNP and NPN types. Construction and working principle. Identifying the leads of the transistor. Transistor as an amplifier. Transistor configurations – CB, CE and CC. Characteristic of CE configuration. α and β factors and their relation. Biasing of transistor.. Operating point. Load line analysis. Performance of the transistor amplifier – input and output resistance, effective collector load, voltage gain and power gain. Graphical representation of working of the single stage amplifier. Field Effect Transistor (FET) – construction and working principle. Difference between BJT and FET.

2. Digital Electronics:

Digital signals. Basic building blocks in digital electronics – NOT, AND and OR gates. The NAND, NOR and EX-OR gates. Boolean algebra, DeMorgan's theorems.

Number system and codes – the decimal, the binary, octal and hexadecimal number systems: conversion from one another.

Combinational logic design : - standard representation of logical functional in SOP and POS forms. Logic design in SOP form – truth table to logic equation to realization using gates. Reduction of logic equations. Introduction to half adder, full adder, BCD to 7 segments display decoder. ADC, DAC(to be treated as black boxes)

**3. Introduction to feed back control systems: -
(For Mechanical Engineering students only)**

Open-loop and closed-loop systems; examples of control systems; definition of linear, non-linear, time-variant, time-invariant, continuous and discrete control systems; characteristics of closed-loop (feedback) control systems, positive and negative feedback systems; transfer function-concept and properties, poles, zeros, pole-zero map and characteristic equation.

Formulation of differential equations for dynamic systems; transfer functions of linear systems; construction of block diagram of control systems, determination of transfer function using block diagram reduction technique.

Time response of control systems- the unit step, unit ramp and unit acceleration test inputs, First and second order systems. Transient response of under-damped second order systems, Steady state errors.

Introduction to stability analysis of feedback control systems; Routh-Hurwitz's stability criterion.

Frequency response analysis of second order systems, relation between time response and frequency response, Bode plot.

4. **Transducers** –

(For Chemical Engineering students only)

Functional elements. Mechanical and electrical transducers. Primary and secondary transducers, active and passive transducers. Inverse transducer_ piezo electric transducers. Basic requirements of transducers.

Temperature transducers – thermistor, thermocouple, characteristics of thermocouple transducers, Resistance-Temperature detector (RTD); Solid state sensor – transistor used as a temperature sensor.

Pressure transducers- elastic element used as pressure sensors – membranes, thin plates corrugated diaphragms, capsules, bellows, Bourdon tube. Transducers types – LVDT type, variable capacitance type, strain gauge type. Displacement transducers –LVDT, RVDT, variable capacitance. Digital transducers.

Flow transducers – restriction flow transducers, obstruction flow transducers, and magnetic transducers.

5. **Electric Heating and Welding:**

Advantage of electric heating. Resistance heating –direct and indirect type. Heating elements. Temperature control.

Electric arc furnace – direct type, indirect type, power supply, and heat control.

Induction Heating – principle, skin effect, depth of penetration; induction furnace – different types.

Dielectric Heating – principle and applications.

Electric welding - arc welding, dc generator for arc welding, welding transformer, Resistance welding.

Books:

- 1) Ogata, K.: Modern Control Engineering (PHI).
- 2) Shawanay, A. K.: Electrical Measurements and Measuring Instruments (Dhanpat Rai)
- 3) Jain, R. P.: Digital Electronics
- 4) Mehta, V. K.: Principles of Electronics (S. Chand & Co.).
- 5) Partab, H.: Art and Science of Utilization of Electrical Energy

6) Elgerd, E.: Utilization of electrical energy

CH 485: Process Calculations

L – T – P

3 – 1 – 0

Time : 3 Hrs

Theory : 100 marks

Sessional : 50 marks

Material balance in Unit Operations: basic material balance Principles, material balance without Chemical reaction. Bypass, recycle, purging.

Material balance with Chemical reaction.

Reaction Equilibrium, equilibrium Constant.

Energy Balance: thermo physics: Law of conservation of Energy, Components of energy Balance Equations, Heat Capacity, Enthalpy Change of Phase Changes, steam tables, Heat of mixing, energy balance in cyclic Processes, energy Balance in Non-flow processes, energy balance in flow processes.

Energy balance: thermo chemistry: Heat effects accompanying chemical reactions, effect of temperature on standard Heat of reaction.

Introduction to Computer Aided Process Calculations: Degrees of Freedom and Specifications, Use of Spreadsheets, Tearing and Iterative Techniques in Flow sheeting.

TEXTBOOKS:

1. O.A.Hougen, K. M. Watson and R. A. Ragatz, "Chemical Process Principles", Vol-I, CBS Publishers and Distributors, New Delhi, 1995.
2. D. Himmelblau, "Basic Principles and Calculations in Chemical Engineering", 5th Edn., Prentice Hall of India Ltd., N. Delhi, 1994.
3. K V narayanan and B Lakshmikutty, Stoichiometry and Proces Calculations
4. V. Venkataramani and N. Anantharaman, "Process Calculations", Prentice Hall of India Ltd., N. Delhi, 2003.

CHE 486 : ENERGY ENGINEERING

L – T – P

3 – 1 – 2

Time :3 Hrs.

Theory : 100 marks.

Sessional : 50 marks.

Practical : 50 marks.

1. **Introduction:** energy crisis, present position in India and the work. Remedial measures. energy resources, Survey, classification and scope of utilization

2. **SOLID FUELS:** Types of solid fuels, classification of coal, origin of coal, Coal composition : Proximate & Ultimate analysis of coal., calorific value of solid fuel : Gross and net calorific value and their determination by Bomb calorimeter, processing of coal, cleaning of coal, coal carbonization, recovery of by-products from coal carbonization, pulverized coal, coal Gasification & Liquefaction.

3. **LIQUID FUELS:** Types of Liquid Fuels., Origin of Petroleum, Composition and classification of Petroleum. Petroleum processing : Distillation, Reforming ,Cracking, Properties and testing of petroleum products including determination of calorific values of liquid fuel by Bomb calorimeter, Important petroleum products, Petroleum refining in India, Coal tar fuel, liquid fuel from coal, (F-T process and Bergius process), Alcohols, Shale oil etc.

4. **GASEOUS FUELS :** Types of gaseous fuels, manufacture of producer gas, water gas, coal gas, carouretted water gas from coal, LPG, SNG, CNG etc., oil gasification.

Gross and net calorific value of gaseous fuel and their experimental determination, Junker's gas calorimeter, Boy's gas calorimeter.

5. INTRODUCTION TO VARIOUS CAMOUSTION EQUIPMENTS

6. **Alternative energy resources:** Hydroelectricity, solar energy, energy from biomass, Animal and vegetable waste conversion, Biomass gasification, utilization of municipal solid waste as a renewable source of energy, Geothermal energy, Wind, Tidal energy.

Its production and future prospects in India.

7. **CALCULATIONS.:** for combustion of solid, liquid & gaseous fuels, for calorific value of solid, liquid & gaseous fuels.

PRACTICALS :

Proximate analysis of coal. Determination of calorific value of solid & liquid fuel by Bomb calorimeter. Determination of calorific value of gaseous fuel by Junkar's Gas calorimeter. Determination of flash point by Abel's apparatus. Determination of flash point by Pensky-Marten apparatus. Determination of flash point & fire point by Cleveland apparatus. Analysis of flue gas by Orsat apparatus. Determination of viscosity by Redwood – I & II Viscometers.

BOOKS

Fuel & Combustion by S. Sarkar.

Combustion Engineering & Fuel Technology by A.K. Saha.

Solid, liquid & gaseous fuels by Brame & King.

Fuel Combustion energy Technology, S N Saha, Dhanpat Rai Publication

CH 487 FLUID FLOW OPERATION

L – T – P
3 – 1 – 2

Time : 3 hrs
Theory : 100 marks
Sessional : 50 marks
Practicals 50 Marks

1. INTRODUCTION : Properties of fluids, compressible and incompressible fluids, Normal forces on fluids, Dimensional analysis.

2. FLUID STATICS : Principle of hydrostatic equilibrium, barometric equation, pressure management manometer.

3. FLUID FLOW PHENOMENA : Velocity field, laminar flow, velocity gradient and rate of shear, Eddie viscosity, viscosity and momentum flux, shear stress field, Newtonian and non-Newtonian fluids, Bingham model, Ostwald-de Waele model of non-Newtonian fluid, turbulent flow, Reynold's experiments, flow in boundary layer, laminar and turbulent flow in boundary layer, transition from laminar to turbulent flow – Reynold's number, boundary layer separation and wake formation.

4. BASIC EQUATION OF FLUID FLOW : Stream lines and stream tubes, average velocity, mass velocity, integral equation of flow – Euler's equation of motion, momentum equation for one dimensional flow under steady state condition, the Bernoulli's equation, its application to pumps, blowers, turbines etc.

5. FLOW OF INCOMPRESSIBLE FLUID IN CONDUITS : Flow of incompressible fluids in pipes, boundary layer formation in straight tube, laminar flow of Newtonian fluids, Hagen-Poiseuille equation, laminar flow of non-Newtonian fluids, velocity distribution for turbulent flow, average velocity, relation between maximum and average velocity, application of dimensional analysis to fluid flow problems – friction factor, pipe roughness, loss of head due to friction, bends, fittings etc.

6. FLOW PAST IMMERSED BODIES : Drag, Drag-co-efficient , turbulence, friction in flow through bed of solids – Kozeny-Carman equation, Blake-Plummer equation, motion of particles through fluids, equation for one dimensional motion of particle through fluid.

7. FLUIDIZATION : Mechanism of fluidization, bath fluidization, minimum porosity, maximum bed density, bed height, pressure drop in fluidized bed, uses of fluidization.

8. TRANSPORTATION AND METERING OF FLUIDS : Orifice meter, Venturimeter, Pitot tube, Rotameter and Weir-its principle, theory and application. Classification and performance of pump, compressor, blower, selection and specification.

9. COMPRESSIBLE FLUIDS : Continuity equation, total energy balance, mechanical energy balance, ideal gas equation, process compressible fluids.

Practicals:

1. Experiment on Reynold's apparatus
2. Experiment on turbulent flow apparatus
3. Flow characteristics through venture meter, orifice meter
4. Verification of Bernoulli's equation.
5. Determination of friction factor at different floe rates for SS aluminum, copper pipe
6. Frictions losses in pipes, bends, fittings etc.

BOOKS:

Unit Operation of Chemical Engg. by – McCabe and Smith.
Chemical Engg. Vol-I by – Coulson and Richardson.
Introduction to Chemical Engg. by – Badger and Banchemo.