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SEMESTER IV

NUMERICAL METHODS
CODE: M (CS) 401
CONTACTS: 2L+1T
CREDITS: 2

Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors. (4L)

Interpolation: Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation. (5L)

Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms. (3L)
Numerical solution of a system of linear equations:
Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method.Numerical solution of Algebraic equation (6L)

Bisection method, Regula-Falsi method, Newton-Raphson method. (4L)

Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference method. (6L)

Text Books:

1. C.Xavier: C Language and Numerical Methods.

2. Dutta & Jana: Introductory Numerical Analysis.
3. J.B.Scarborough: Numerical Mathematical Analysis.
4. Jain, Iyengar , & Jain: Numerical Methods (Problems and Solution).

References:

1. Balagurusamy: Numerical Methods, Scitech.
2. Baburam: Numerical Methods, Pearson Education.
3. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.
4. Soumen Guha & Rajesh Srivastava: Numerical Methods, OUP.
5. Srimanta Pal: Numerical Methods, OUP.

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UNIT OPERATIONS OF CHEMICAL ENGINEERING – I
CHE 414
CONTACTS: 2L
CREDITS: 2

Module I (10L):

Basic Concepts of Fluid Mechanics : Dimensional Analysis: Buckingham Pi-theorem, Dimensionless groups, Conversion of equations. Basic equations of Fluid Flow, Hagen Poiseille equation, Bernoulli Equation, Fluid Friction. Friction in flow through packed beds, fundamentals of fluidization.

Module II (10L):

Flow measurements and machineries : Flow through pipes and open channels, Orifice and Venturimeters, Pitot Tube, Weirs, Rotameters and other types of meters, Transportation of fluids, Pipe Fittings and valves, Pumps – classification, centrifugal and positive displacement type – peristaltic. Blowers and compressors (oil-free).

Module III (10L):

Heat transfer: Classification of heat flow processes, conduction, Thermal conductivity. Heat flow in fluids by conduction and convection. Countercurrent and parallel flow. Enthalpy balance in heat exchange equipment. Individual heat transfer coefficients, overall coefficient, Heating and cooling of fluids, Heat transfer equipment. Unsteady state heat transfer, Radiation.

Module IV (10L):

Mechanical Operations: Principles of comminution, Types of comminuting equipment. Energy and power requirement, Crushers, Grinders, Mixing and Agitations, Power consumption in mixing, Mechanical separation, Screening, Types of screen, Filtration, Principle of Constant pressure and constant rate filtration, Settling classifiers, Floatation, Centrifugal separations.

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Revision: 5L

Books :

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
3. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
4. Heat Transfer: D.Q. Kern, MGH
5. Badger, W.L., Banchero, J.T., Introduction to Chemical Engineering, MGH
6. Foust, A.S., Wenzel, L.A., et.al. Principles of Unit Operations, 2nd edition, JWS
7. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH
8. Unit operations and unit processes for Engineers and Biologists; B. C. Bhattacharya and C. M. Narayanan; Khanna Publications, Delhi
9. Mechanical Operations for Chemical Engineers; C. M. Narayanan and B. C. Bhattacharya; Khanna Publishers, Delhi

MATHEMATICS 3
CODE: M 402
CONTACTS: 2L +1T
CREDITS: 2

Note 1: The entire syllabus has been divided into four modules.
Note 2: Structure of Question Paper
There will be two groups in the paper:
Group A: Ten questions, each of 2 marks, are to be answered out of a total of 15 questions, covering the entire syllabus.
Group B: Five questions, each carrying 10 marks, are to be answered out of (at least) 8 questions.

Students should answer at least one question from each module.

[At least 2 questions should be set from each of Modules II & IV. At least 1 question should be set from each of Modules I & III. Sufficient questions should be set covering the whole syllabus for alternatives.]

Module I: Fourier Series & Fourier Transform [8L]

Topic: Fourier Series:

Sub-Topics: Introduction, Periodic functions: Properties, Even & Odd functions: Properties, Special wave forms: Square wave, Half wave Rectifier, Full wave Rectifier, Saw-toothed wave, Triangular wave.   (1)

Euler's Formulae for Fourier Series, Fourier Series for functions of period 2π, Fourier Series for functions of period 2l, Dirichlet's conditions, Sum of Fourier series. Examples.   (1)

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Theorem for the convergence of Fourier Series (statement only). Fourier Series of a function with its periodic extension. Half Range Fourier Series: Construction of Half range Sine Series, Construction of Half range Cosine Series. Parseval's identity (statement only). Examples. (2)

Topic: Fourier Transform:

Sub-Topics: Fourier Integral Theorem (statement only), Fourier Transform of a function, Fourier Sine and Cosine Integral Theorem (statement only), Fourier Cosine & Sine Transforms. Fourier, Fourier Cosine & Sine Transforms of elementary functions. (1)

Properties of Fourier Transform: Linearity, Shifting, Change of scale, Modulation. Examples. Fourier Transform of Derivatives. Examples. (1)
Convolution Theorem (statement only), Inverse of Fourier Transform, Examples. (2)

Module II : Calculus of Complex Variable [13L]

Topic: Introduction to Functions of a Complex Variable.

Sub-Topics:
Complex functions, Concept of Limit, Continuity and Differentiability. (1)

Analytic functions, Cauchy-Riemann Equations (statement only). Sufficient condition for a function to be analytic. Harmonic function and Conjugate Harmonic function, related problems. (1)
Construction of Analytic functions: Milne Thomson method, related problems**.** (1)

Topic: Complex Integration.
Sub-Topics: Concept of simple curve, closed curve, smooth curve & contour. Some elementary properties of complex Integrals. Line integrals along a piecewise smooth curve. Examples. (2)

Cauchy's theorem (statement only). Cauchy-Goursat theorem (statement only). Examples. (1)

Cauchy's integral formula, Cauchy's integral formula for the derivative of an analytic function, Cauchy's integral formula for the successive derivatives of an analytic function. Examples. (2)
Taylor's series, Laurent's series. Examples (1)

Topic: Zeros and Singularities of an Analytic Function & Residue Theorem.
Sub-Topics: Zero of an Analytic function, order of zero, Singularities of an analytic function. Isolated and non-isolated singularity, essential singularities. Poles: simple pole, pole of order m. Examples on determination of singularities and their nature. (1)
Residue, Cauchy's Residue theorem (statement only), problems on finding the residue of a given function, evaluation of definite integrals: $\oint \frac{\sin x}{x} dx$, $\oint^{2\pi} \frac{\theta}{a + b\cos\theta + c\sin\theta} dx$, $\int_c \frac{P(z)}{P(z)} dz$

(elementary cases, P(z) & Q(z) are polynomials of 2nd order or less).

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Topic: Introduction to Conformal Mapping.

Sub-Topics:
Concept of transformation from z-plane to w-plane. Concept of Conformal Mapping. Idea of some standard transformations. Bilinear Transformation and determination of its fixed point.

(1)

Module III: Probability [8L]

Topic: Basic Probability Theory

Sub-Topics:
Classical definition and its limitations. Axiomatic definition.

Some elementary deduction: i) $P(O)=0$, ii) $0 \leq P(A) \leq 1$, iii) $P(A')=1-P(A)$ etc. where the symbols have their usual meanings. Frequency interpretation of probability. (1)
Addition rule for 2 events (proof) & its extension to more than 2 events (statement only). Related problems. Conditional probability & Independent events. Extension to more than 2 events (pairwise & mutual independence). Multiplication Rule. Examples. Baye's theorem (statement only) and related problems. (3)

Topic: Random Variable & Probability Distributions. Expectation.

Sub-Topics:
Definition of random variable. Continuous and discrete random variables. Probability density function & probability mass function for single variable only. Distribution function and its properties (without proof). Examples. Definitions of Expectation & Variance, properties & examples. (2)
Some important discrete distributions: Binomial & Poisson distributions and related problems.
Some important continuous distributions: Uniform, Exponential, Normal distributions and related problems. Determination of Mean & Variance for Binomial, Poisson & Uniform distributions only. (2)

**Module IV: Partial Differential Equation (PDE) and Series solution of
Ordinary Differential Equation (ODE) [13L]**

Topic: Basic concepts of PDE.

Sub-Topics:
Origin of PDE, its order and degree, concept of solution in PDE. Introduction to different methods of solution: Separation of variables, Laplace & Fourier transform methods. (1)

**Topic: Solution of Initial Value & Boundary Value PDE's by Separation of variables,
Laplace & Fourier transform methods.**

Sub-Topics:

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PDE I: One dimensional Wave equation.   (2)
PDE II: One dimensional Heat equation.   (2)
PDE III: Two dimensional Laplace equation.   (2)

Topic: Introduction to series solution of ODE.

Sub-Topics:
 Validity of the series solution of an ordinary differential equation. General method to solve Po $y''+P1\ y'+P2\ y=0$ and related problems.   (2)

Topic: Bessel's equation.

Sub-Topics:
Series solution, Bessel function, recurrence relations of Bessel's Function of first kind.   (2)

Topic: Legendre's equation.

Sub-Topics:
Series solution, Legendre function, recurrence relations and orthogonality relation.   (2)

Text Books:

1. Brown J.W and Churchill R.V: Complex Variables and Applications, McGraw-Hill.
2. Das N.G.: Statistical Methods, TMH.
3. Grewal B S: Higher Engineering Mathematics, Khanna Publishers.
4. James G.: Advanced Modern Engineering Mathematics, Pearson Education.
5. Lipschutz S., and Lipson M.L.: Probability (Schaum's Outline Series), TMH.

References:

1. Bhamra K. S.: Partial Differential Equations: An introductory treatment with applications, PHI
2. Dutta Debashis: Textbook of Engineering Mathematics, New Age International Publishers.
3. Kreyzig E.: Advanced Engineering Mathematics, John Wiley and Sons.
4. Potter M.C, Goldberg J.L and Aboufadel E.F.: Advanced Engineering Mathematics, OUP.
5. Ramana B.V.: Higher Engineering Mathematics, TMH.
6. Spiegel M.R. , Lipschutz S., John J.S., and Spellman D., : Complex Variables, TMH.

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STRUCTURAL ANALYSIS-A
CODE: CE402A
CONTACT: 2L + 1 T
CREDITS: 2

Review of basic concept of mechanics: Equilibrium, Free body diagram, Determinate and Indeterminate structures, Degree of indeterminacy for different types of structures: Beams, Frames, Trusses   4L

Analysis of determinate structures: Portal frames, arches, cables   4L

Strain energy: Due to axial load, bending and shear, Torsion; Castigliano's theorems, theorem of minimum potential energy, principle of virtual work, Maxwell's theorem of reciprocal deflection, Betti's law   4L
Deflection determinate structures: Moment area and Conjugate beam method, Energy methods, Unit load method for beams, Deflection of trusses and simple portal frames.   8L

References
1 Engineering Mechanics of Solids By E. P. Popov Pearson Education
2 Basic structural Analysis C.S. Reddy TMH
3 Statically indeterminate structures C. K. Wang McGraw-Hill
4 Elastic analysis of structures Kennedy and Madugula Harper and Row
5 Structural Analysis (Vol I & Vol II) S S Bhavikatti Vikas Publishing House Pvt. Ltd
6 Structural Analysis Ramammurtham
7 Structures Schodek & M. Bechhold Pearson Education

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STRUCTURAL ANALYSIS-B
CODE: CE402B
CONTACT: 2L + 1 T
CREDITS: 2

Influence line diagrams: Statically determinate beams and trusses under series of concentrated and uniformly distributed rolling loads, criteria for maximum and absolute maximum moments and shears.   6L

Analysis of statically Indeterminate beams: Theorem of three moments, Energy methods, Force method (method of consistent deformations) [for analysis of propped cantilever, fixed beams and continuous beams (maximum two degree of indeterminacy) for simple loading cases], Analysis of two-hinged arch.   8L

Analysis of statically indeterminate structures:
Moment distribution method - solution of continuous beam, effect of settlement and rotation of support, frames with or without side sway. Slope Deflection Method – Method and application in continuous beams and Frames. Approximate method of analysis of structures: Portal & Cantilever methods   8L

References
1 Engineering Mechanics of Solids By E. P. Popov Pearson Education
2 Basic structural Analysis C.S. Reddy TMH
6 Statically indeterminate structures C. K. Wang McGraw-Hill
7 Elastic analysis of structures Kennedy and Madugula Harper and Row
8 Structural Analysis (Vol I & Vol II) S S Bhavikatti Vikas Publishing House Pvt. Ltd
6 Structural Analysis Ramammurtham
7 Structures Schodek & M. Bechhold Pearson Education

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SOIL MECHANICS-A
CODE: CE403A
CONTACT: 2L+1T
CREDITS: 2

Introduction: Origin & formation of Soil: Types, Typical Indian Soil, Fundamental of Soil Structure, Clay Mineralogy   2

Physical & Index properties of soil: Weight- Volume Relationships, Insitu Density, Moisture Content, Specific Gravity, Relative Density, Atterberg's Limits, Soil Indices, consistency of soil ,Particle Size Distribution of soil: Sieving, Sedimentation Analysis   6

Identification & Classification of soil: Field identification of soil, Soil Classification: as per Unified Classification System, IS Code Recommendation, AASHTO Classification   4

Flow through soil: Darcy's Law, Coefficient of permeability, laboratory and field determination of coefficient of permeability, Permeability for Stratified Deposits, Laplace's Equations, Flow nets, Flow Through Earthen Dam, Estimation of Seepage, Uplift due to seepage   6

Effective Stress Principles: Effective Stress, Effective pressure due to different conditions, Seepage force, Critical hydraulic gradient, Quick sand condition, Design of filters, Capillarity in soil   4

Stress Distribution In Soil: Normal and shear stresses, Stress due to point loads, Stress beneath Line, strip & uniformly loaded circular area & rectangular area, pressure bulbs, Newmark's charts- Use for determination of stress due to arbitrarily loaded areas   4

References

1 Principles of Geotechnical Engineering B. M. Das Thomson Book Store
2 Text book of Soil Mechanics & Foundation Engineering V.N.S. Murthy CBS Publisher's & Distributors
3 Geotechnical Engineering – Principles and Practice Coduto Pearson Education
4 Soil Mechanics Lambe & Whitman. WIE
5 Basic & Applied Soil Mechanics Gopal Ranjan & A.S.R.Rao Willes EasternLtd
6 SP 36 (Part I) Numerical Problems – Geotechnical Engineering Rao & Venkatramaiah University Press

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SOIL MECHANICS-B
CODE: CE403B
CONTACT: 2L+1T
CREDITS: 2

Compaction of soil: Principles of Compaction, IS Light & Heavy Compaction Test, Field Compaction, Various methods of field compaction and control   4

Compressibility & Consolidation of Soil: Terzaghi's theory of one dimensional consolidation, Compressibility characteristics of soils: Compression index, Coefficient of compressibility & volume change, Coefficient of consolidation, Degree & rate of consolidation, Laboratory method of one dimensional consolidation test, Determination of consolidation parameters, Secondary consolidation   6

Shear Strength of Soil: Basic concepts, Mohr- Columb's Theory, Laboratory Determination of soil shear parameter- Direct Shear, Tri-axial Test, Unconfined Compression, Vane Shear Test, Sensitivity & thixotropy of clay.   6

References

4 Principles of Geotechnical Engineering B. M. Das Thomson Book Store
5 Text book of Soil Mechanics & Foundation Engineering V.N.S. Murthy CBS Publisher's & Distributors
6 Geotechnical Engineering – Principles and Practice Coduto Pearson Education
4 Soil Mechanics Lambe & Whitman. WIE
7 Basic & Applied Soil Mechanics Gopal Ranjan & A.S.R.Rao Willes EasternLtd
8 SP 36 (Part I) Numerical Problems – Geotechnical Engineering Rao & Venkatramaiah University Press

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PRACTICAL

TECHNICAL REPORT WRITING & LANGUAGE LAB PRACTICE
CODE: HU481
CONTACTS: 3P
CREDITS:2

Guidelines for Course Execution:
Objectives of this Course: This course has been designed:

1. To inculcate a sense of confidence in the students.
2. To help them become good communicators both socially and professionally.
3. To assist them to enhance their power of Technical Communication.
Detailed Course Outlines:

A. *Technical Report Writing*: 2L+6P
1. Report Types (Organizational / Commercial / Business / Project)
2. Report Format & Organization of Writing Materials
3. Report Writing (Practice Sessions & Workshops)

B. Language Laboratory Practice
1. Introductory Lecture to help the students get a clear idea of Technical Communication & the need of Language Laboratory
Practice Sessions   2L

2. Conversation Practice Sessions: (To be done as real life interactions)
                                                                                                        2L+4P
a) Training the students by using Language Lab Device/Recommended Texts/cassettes /cd's to get their Listening Skill & Speaking Skill honed
b) Introducing Role Play & honing over all Communicative Competence

3. Group Discussion Sessions: 2L+6P
a) Teaching Strategies of Group Discussion
b) Introducing Different Models & Topics of Group Discussion
c) Exploring Live /Recorded GD Sessions for mending students' attitude/approach & for taking remedial measure

Interview Sessions: 2L+6P
a) Training students to face Job Interviews confidently and successfully
b) Arranging Mock Interviews and Practice Sessions for integrating Listening Skill with Speaking Skill in a formal situation for effective communication

4. Presentation: 2L+6P
a) Teaching Presentation as a skill
b) Strategies and Standard Practices of Individual /Group Presentation
c) Media & Means of Presentation: OHP/POWER POINT/ Other Audio-Visual Aids

5. Competitive Examination: 2L+2P
a) Making the students aware of Provincial /National/International Competitive Examinations
b) Strategies/Tactics for success in Competitive Examinations

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c) SWOT Analysis and its Application in fixing Target

Books – Recommended:

Nira Konar: English Language Laboratory: A Comprehensive Manual PHI Learning, 2011
D. Sudharani: Advanced Manual for Communication Laboratories &

Technical Report Writing
Pearson Education (W.B. edition), 2011

References:

Adrian Duff et. al. (ed.): Cambridge Skills for Fluency
A) Speaking (Levels 1-4 Audio Cassettes/Handbooks)
B) Listening (Levels 1-4 Audio Cassettes/Handbooks) Cambridge University Press 1998

Mark Hancock: English Pronunciation in Use 4 Audio Cassettes/CD'S OUP 2004

NUMERICAL METHODS LAB
CODE: M (CS) 491
CONTACT: 2P
CREDIT: 1

1. Assignments on Newton forward /backward, Lagrange's interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule.
3. Assignments on numerical solution of a system of linear equations using Gauss elimination and Gauss-Seidel iterations.
4. Assignments on numerical solution of Algebraic Equation by Regular-falsi and Newton Raphson methods.
5. Assignments on ordinary differential equation: Euler's and Runga-Kutta methods.
6. Introduction to Software Packages: Matlab / Scilab / Labview / Mathematica.

SURVEYING PRACTICE II
CODE: CE492
CONTACT: 3P
CREDITS: 2

1. Traversing by Using Theodolite: Preparation of Gales Table from field data
2. Traversing by using Total Station
3. Use of Total Station for leveling and Contouring
4. Setting out of Simple Curves

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SOIL MECHANICS LAB – I
CODE: CE493
CONTACT: 3P
CREDITS: 2

1. Field identification of different types of soil as per Indian standards [collection of field samples and identifications without laboratory testing], determination of natural moisture content.
2. Determination of specific gravity of i) Cohesionless ii) cohesive soil
3. Determination of Insitu density by core cutter method & sand replacement method.
4. Grain size distribution of cohessionless soil by sieving & finegrained soil by hydrometer analysis.
5. Determination of Atterberg's limits (liquid limit, plastic limit & shrinkage limit).
6. Determination of co- efficient of permeability by constant head pemeameter (coarse grained soil) & variable head parameter (fine grained soil).
7. Determination of compaction characteristics of soil.

References:

1. Soil Testing by T.W. Lamb (John willey)
2. 2. SP-36 (Part I- & Part – II)
3. Soil Mechanics Laboratory Manual by Braja Mohan Das, OXFORD UNIVERSITY PRESS
4. Measurement of Engineering properties of soil by E Saibaba Reddy & K. Rama Sastri. (New age International publication.

UNIT OPERATION LAB – I
CODE: CHE 484
CONTACT: 3P
CREDITS: 2

1. Experiments on Reynolds's Apparatus –Determination of flow regime and construction of friction factor against NRE.
2. Experiments on flow measuring device — in closed conduit using (a) Venturimeter, (b) Orifice meter, (c) Rotameter.
3. Determination of Pressure drop for flow through packed bed & verification of Ergun Equation, Kozeny-Karman equation, Blake-Plummer Equation.
4. To study the working characteristics of a Jaw Crusher, calculate the energy consumption as a function of size reduction and compare it with the actual energy requirements.
5. To study the working characteristics of a Ball Mill, calculate the energy consumption as a function of size reduction and determine the critical speed.
6. To Determine the Overall heat transfer coefficient of a concentric pipe heat exchanger based on the inside diameter of the tube.
7. To study the characteristics of film-wise/drop-wise condensation.