Subject Name : MATHEMATICS

Code: M 402

Contacts: 3L +1T = 4

Credits: 4

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)

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: $\int_0^\infty \frac{\sin x}{x}dx$, $\int_0^{2\pi} \frac{d\theta}{a+b\cos\theta+c\sin\theta}$, $\int_C \frac{P(z)}{Q(z)}dz$ (elementary cases, P(z) & Q(z) are polynomials of 2nd order or less).   (2)

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≤P(A)≤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:
 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 $P_0 y'' + P_1 y' + P_2 y = 0$ 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)

TOTAL LECTURES : 42

Text Books:
    2.   Brown J.W and Churchill R.V: Complex Variables and Applications, McGraw-Hill.
    3.   Das N.G.: Statistical Methods, TMH.
    4.   Grewal B S: Higher Engineering Mathematics, Khanna Publishers.
    5.   James G.: Advanced Modern Engineering Mathematics, Pearson Education.
    6.   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.