Syllabus for the First Degree Programme in Mathematics
of the University of Kerala

Semester V
Complex Analysis

Code: MM 1542 Instructional hours per week: 4
No.of credits: 3

Module 1 Review of real functions like sin x, cos x, e^x and their series representations. In order to introduce complex numbers, we first consider complex polynomials and ra-tional functions. Then power series and convergence of power series are discussed. We then use power series to obtain some complex functions. (For example, the power series $1 + z + z^2 + \dots$ gives the complex function $\frac{1}{1-z}$ as its sum when $|z| < 1$.)

Similarly, we define e^z, sin z, cos z, etc. as the sums of certain power series. Next, we introduce the concepts of limit, continuity and differentiability through examples and counter-examples. Cauchy-Riemann equations are derived in Cartesian and polar coordinates.

Module 2 Properties of differentiable complex functions on open sets (called anlytic func-tions): for f and g analytic on an open set Ω, we have f ± g, f g, f /g, where g 6= 0 are analytic on Ω. Taylor Series and Laurent Series (without proof) with illustrations.

Defintion of harmonic functions. Connection between harmonic and analytic func-tions. Harmonic conjugates. Determination of harmonic conjugates. Orthogonal family of curves. Connection between analytic functions and orthogonl family of curves.

Module 3 Mapping properties of $w = z^2$, $w = \frac{1}{z}$, w = sin z, $w = e^z$. The concept of confor-mal mapping is introduced through various examples. Criterion for the conformality of the mapping w = f(z) (without proof).

The concept of the Riemann sphere is introduced. Bilinear transformations. Prop-erties of bilinear transformations. Decomposition of a bilinear transformation into special transformations such as translation, dialation and inversion. Special bilinear fractional transformations.

Text: R V Churchill and Brown: Functions of a Complex Variable

References:

1. J M Howie: Complex Analysis, Springer

2. V Karunakaran: Complex Analysis

Distribution of instructional hours:

Module 1: 24 hours; Module 2: 24 hours; Module 3: 24 hours

Syllabus for the First Degree Programme in Mathematics
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Semester V
Differential Equations and their Applications

Code: MM 1543 Instructional hours per week: 4
No. of credits: 3

Module 1 Various situations in which we obtain differential equations are discussed. These could be exercises or assignments for the students. For example, Newton's second law: $\tilde{F} = m\tilde{a}$, that is, $\tilde{F} = m\frac{d^2x}{dt^2}$. The case of the simple pendulum, CLR circuit, planetary motion, etc. The half-life of radium (Chemistry), Prey-predator model (Ecology-Biology), etc.

Orthogonal trajectories, Exact equations, integrating factors, Existence and uniqueness of solutions, Picard's theorem (statement only) and some simple problems.

Non-linear differential equations of the first order, Clairaut's form, Singular solu-tions, Geometrical meaning of solutions.

Writing down a second order equation as a set of two first order

equations. A brief history of Kepler, Gauss and Riemann can be given.

Module 2 Second order (higher order) differential equations with constant coefficients, (LCR circuit, forced oscillations, vibration of spring problem etc.) Complemetary func-tion and particular integral. Solution by method of undetermined coefficients. Differential equations with various types of functions on the RHS like e^{ax}, sin ax, cos ax, x^m, $e^{ax}V$ (x) etc.

Simultaneous eqations (Prey-predator equation, velocity components in x and y direction, Lorentz system etc.)

Solution of simultaneous differential equations.

Module 3 The Euler-Cauchy equidimensional equation. Second order equations with variable coefficients. Finding the complete solution when one solution is known. Method of variation of parameters, Wronskian and its properties.

Laplace transform-Laplace transform as a linear integral transform, Properties of the Laplace transform, Finding the Laplace transform of a function, inverse Laplace transform, convolution theorem, Laplace transform of derivatives and integrals. Applications to the solution of differential equations, Mention of the Fourier sine and cosine transforms.

Text: G F Simmons: Differential Equations with applications and historical notes, Tata Mc-Graw Hill, 2003

References:

1. Kreyzig, Advanced Engineering Mathematics, 8th edition, John Wiley.
2. Peter V. O' Neil, Advanced Engineering Mathematics, Thompson Publications, 2007

3. Michael D. Greenberg, Advanced Engineering Mathematics, Pearson Education, 2002.

Distribution of instructional hours:

Module 1: 24 hours; Module 2: 24 hours; Module 3: 24 hours

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Semester V
Numerical Methods

Code: MM 1544 Instructional hours per week: 3
No. of credits: 3

Module 1 We begin with an explanation of algebraic and transcendental functions. Fundamental theorem of algebra, application of location of roots theorem, Bisection method of obtaining one root, intersection method, Regula-Falsi method, Newton-Raphson method of obtaining roots, different types of errors, applications of errors, convergence of the methods.

Use computers to draw the graphs of linear, quadratic and cubic equations in one variable and locate their roots.

Module 2 Review of the different methods (Cramer's rule, matrix - inverse method, using ma-trix transformations) to find the solution of linear equations. Gaussian elimination method, Gauss - Jordan method, Gauss-Siedel method and Jacobi methods.

Solving first order non-linear differential equations by Picard's method, solving first order differential equations by Taylor series method, Euler method (commer-cial solution), modified Euler method (commercial solution), Runge-Kutta method (commercial solution).

Module 3 Finite difference operators like , E, δ, r and their relations, interpolation with equal intervals, Newton's forward interpolation, Newton's backward interpolation, Stirling's formula, interpolation with unequal intervals, Lagrange's formula, inverse interpolation.

Finding first and second derivatives using Newton's forward and backward formula and Stirling's formula, finding the maxima and minima of a given data, general quadrature formula for numerical integration, Trapezoidal rule, Simpson's $\frac{1}{3}$ rule and Simpson's $\frac{3}{8}$ rule.

Assignments / Projects : Students must be encouraged to write computer programs and solve different problems.

Text: S S Sastry: Introductory Methods of Numerical Studying, PHI

References:

1. G F Simmons: Differential Equations with Historical Notes
2. Erwin Kreyszig: Advanced Engineering Mathematics
3. K Sankara Rao: Numerical Methods for Scientists and Engineers, PHI

Distribution of instructional hours:

Module 1: 18 hours; Module 2: 18 hours; Module 3: 18 hours

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Semester V
Computer Programming-I

Code: MM 1545 Instructional hours per week: 5
No.of credits: 4

Module 1 Algorithms and data (15 hours)

Control structures, combining control structures, the goto statement, diagrams for algorithms, subroutines, recursion, a solution to the "Tower of Hanoi", power con-trol structurers, data types and data structures, variables, vectors, arrays, queues and stacks, trees, tree sort.

Text: David Harel, Algorithmics-The Spirit of Computing, Second edition, Pear-son Education Asia, Section 2 of Part I

Module 2 Basic UNIX commands and concepts (25 hours of which 12 hours are for lab.)

Logging in, setting a password, virtual consoles, popular commands, shells, file-name extension, saving output, manual pages, file ownership and permission, changing owner group and permission, start-up files, important directories, pro-cess.

Programming with gcc: gcc features, basic gcc usage, using multiple source files, enabling debugging code, creating libraries and shared libraries.

Text: Matt Welsh et al., Running Linux- O'REILLY - Third Edition.
Chapter 4 and Section1 1 of Chapter 12

Module 3 C language—Basic syntax and examples (25 hours of which 12 hours are for lab.)

Variables, operators(relational, logical, increment and decrement, etc.), formated input/output, control structure (if, if-else, nested if-else), loops (while, do-while, for, switch-case), simple programs. One dimensional and two di-mensional arrays, strings, programs: bubble sorting, addition multiplication and transpose of matrices.

Text: E. Balaguruswamy, Programming in ansi C

Module 4 Pointers and structures in C (25 hours of which 12 hours are for lab.)

Understanding pointers—declaring and initializing pointer, pointer variable, pointer expressions, pointers and arrays, simple programs on pointers; Structure—definition and initialisation, comparison of structure.

Variables, arrays of structures, arrays within structures, structure within arrays, pointers and structures, structures and functions, simple programs.

Text: E. Balaguruswamy, Programming in ansi C

Syllabus for the First Degree Programme in Mathematics
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Semester V
Operations Research (Open Course)

Code: MM 1551 Instructional hours per week: 2
No. of Credits: 2

Module 1 Linear Programming: Formulation of Linear Programming models, Graphical solution of Linear Programs in two variables, Linear Programs in standard form - basic variable - basic solution- basic feasible solution -feasible solution, Solution of a Linear Programming problem using simplex method - Big-M simplex method.

Module 2 Transportation Problems: Linear programming formulation - Initial basic feasible solution (Vogel's approximation method/North-west corner rule) - degen-eracy in basic feasible solution - Modified distribution method - optimality test.

Assignment problems: Standard assignment problems - Hungarian method for solving an assignment problem.

Project Management: Activity -dummy activity - event - project network, CPM (solution by network analysis only), PERT.

Module 3 Queueing Models: Examples of queues-queue discipline-Kendall's notation-analysis of steady state distribution and performance evaluation of M/M/1, M/M/c/N - Erlang's loss formula.

Text: Ravindran - Philps - Solberg: Operations Research- Principles and Practice

Reference:

Hamdy A Taha: Operations Research

Distribution of instructional hours:

Module 1: 12 hours; Module 2: 12 hours; Module 3: 12 hours