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

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: $\vec{F} = m\vec{a}$, that is, $\vec{F} = m\dfrac{d^2x}{dt^2}$. 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 solutions, 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 function 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 McGraw Hill, 2003

REFERENCES:

1. Kreyzig, *Advanced Engineering Mathematics*, 8^{th} 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