Tentative lecture schedule MTH203

Lecture	Topics
1	Introduction to differential equation (DE), Order of DE, IVP, BVP, IVBP, First order ODE $F(x, y, y') = 0$.
2	Concept of solution (general solution, singular solution,implicit solution etc.), Geometrical interpretations (direction fields, nullclines)
3	Separable form, Reduction to separable form, Exact equations, Integrating factors [of the form F(x) and F(y)]
4	Linear equations, Bernoulli equations, orthogonal trajectories.
5	Picard's existence and uniqueness theorem (without proof), Picard's iteration method
6	Numerical methods: Euler's method, improved Euler's method
7	Second order linear ODE: fundamental system and general solutions of homogeneous equations, Wronskian, reduction of order.
8	Characteristic equations: real distinct roots, complex roots, repeated roots.
9	Non-homogeneous equations: undetermined coefficients
10	Non-homogeneous equations: variation of parameters
11	Extension to higher order differential equations, Euler-Cauchy equation.
12	Power series solutions: ordinary points (Legendre equation).
13	Power series solutions: regular singular points (Bessel equation), Frobenius method, indicial equations.
14	Legendre polynomials and properties
15	Bessel functions and properties
16	Strum comparison theorem
17	Laplace transform: Laplace and inverse Laplace transforms, first shifting theorem, existence
18	Laplace transform: Transforms of derivative and integral, Initial value problems (partial fractions)
19	Laplace transform: unit step function, second shifting theorem, differentiation and integration of transforms
20	Laplace transform: Convolution and applications

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Lecture	Topics
21	Strum-Liouville boundary value problems, orthogonal functions.
22	Fourier series: Fourier series, convergence of Fourier series
23	Fourier series: Fourier series of arbitrary period, Sine and cosine series
24	Fourier series: Half range expansion, Fourier integrals
25	PDE: introduction, linear, nonlinear (semi-linear, quasilinear), examples, well-posedness (unique solution, no solution, infinite no. of solutions).
26	First order linear and semilinear PDEs, method of characteristics, general solutions
27	First order quasilinear PDEs, interpretation, general solutions.
28	Classification of 2nd order PDEs, Reduction to standard form: hyperbolic,parabolic and elliptic
29	Wave equations: D'Alemberts formula, Duhamel's principle
30	Wave equations: Solutions for initial boundary value problem
31	Heat equations: Uniqueness and maximum principle, applications
32	Heat equations: Solutions for initial boundary value problem
33	Laplace and Poisson equations: Uniqueness and maximum principle for Dirichlet problem
34	Laplace and Poisson equations: Boundary value problems in 2D
35 & 36	Laplace and Poisson equations: Boundary value problems in 3D