Semester III: Course Number: MAT 501/ AMAT 501 Functional Analysis Credits 6

Objective: To introduce Banach and Hilbert spaces.

Unit I : Definition of normed linear spaces, Banach spaces, continuity of norm, joint continuity of vector addition and scalar multiplication in normed linear spaces, quotient spaces.

Unit II : Continuous linear transformations and different criterions of continuity of linear transformations on normed linear spaces, space of bounded linear transformations, isometric isomorphism, equivalent norms, Conjugate spaces, Hahn-Banach theorem and its consequences, natural imbedding of normed linear space into its second conjugate.

Unit III : The Open Mapping theorem, projections on Banach spaces, the Closed graph theorem, the Uniform Boundedness theorem, conjugate of an operator, Inner product spaces, Schwarz's inequality, joint continuity of an inner product, parallelogram law in inner product spaces.

Unit IV: Hilbert spaces, Orthogonal complements, Orthonormal sets, Bessel's inequality, conjugate space of a Hilbert space, adjoint of an operator, self-adjoint operators, normal and unitary operators.

Unit V: Project.**Research Component**

Outcome: The students will be able to study various fixed point theorems and spectrum of normal and self-adjoint operators which will be useful to them in existence of solution of various equations.

Text Book: Introduction to topology and modern analysis, G. F. Simmons (Tata McGraw-Hill Edition 2004)
Reference Book: Principles of Functional Analysis, Martin Schechter (American Mathematical Society, 2002)

Semester – III Course No: MAT-502/ AMAT -502 Credits: 6
Partial Differential Equations

Objectives: To know: Fundamentals of DE and PDE, General analysis of PDE, Fundamentals Linear and Nonlinear PDE and Fundamentals Jacobi's method, Charpit's Method

Unit-I First order partial differential equation, linear equations of the first order, integral surface passing through a curve, surfaces orthogonal to a given system of surfaces.

Unit-II Non-linear partial differential equations of the first order, Cauchy's method of characteristics, compatible system of first order equations (condition of compability), Charpit's method.

Unit-III Special types of first order equations, solutions satisfying given conditions,
a) Integral surface through a curve.(b) Derivation of one complete integral from another.

Professor and Head
Department of Mathematics
Dr. Babasaheb Ambedkar
Marathwada University,
Aurangabad-431004

(c) Integral surfaces circumscribing a given surfaces.Jocobi's method for solving $F(x, y, z, p, q) = 0$.

Unit-IV The origin of second order equations, linear partial differential equations with constant coefficients, intermediate integrals or first integrals, Monge's method of integrating $Rr + Ss + Tt = V$, classification of second order partial differential equation (Canonical form).

Unit-V Project: **Research Component.**

Outcomes: Student will become familiar with DE and PDE to find the solutions,
Student will be able to analysis to classify the second order PDE, Student will become familiar with how to find the general solution of PDE by using Jacobi's method, Charpit's Method.

Text book:Ian Sneddon: Elements of Partial Differential Equation, Dover Publication, McGraw – Hill Book Company, New York, 1957. (Chapters 2, 3, 5 and 6)

Reference books: (1) T. Amarnath: An elementary course in partial differential equation (2nd Edition) – Narosa Publishing House 2003.
(2) Lawrence C. Evance: Partial Differential Equations, Graduate Studies in Mathematics Volume 19, AMS 1998.
(3) M.D. Raisighania: Ordinary and Partial Differential Equation, S. Chand & Company Ltd, New Delhi.

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Semester – III **MAT 521 MATLAB Programming** **Credits 6**

Objective: The main objective of the paper is to study the MATLAB programming language to solve numerical problems

Unit – IIntroduction: Input / out put of Data from MATLAB Command, file Types, Creating saving and, Executing the Script file, Creating and executing functions file, working with files and directories.
Matrices: Matrix manipulation, creating vectors. Arithmetic operations. Relational operations, Logical operations, matrix functions, Determinant of matrix, Eigen values and Eigen vectors.

Unit – IIProgramming in Matlab: function files, sub functions, Global Variables, Loops, branches and control flow, Interactive input, Recursion, Publishing a report, Controlling Command Windows, Command line Editing.

Unit – IIILinear algebra and Interpolation: solving a linear system, Gaussian elimination, Matrix factorizations, Curve fitting, Polynomial curve fitting, Least squares curve fitting, General nonlinear fits, Interpolation.

Unit – IVDifferential equations & Graphics: First order linear ODE, Second order ODE, Double integration, Roots of Polynomial, 2-d plots, 3-D plots, Matlab Plotting tools, Mesh and Surface Plots.

Unit –V.. Project: **Research Component.**

Outcome: After learning this paper student will be able to write the mathematical programs in MATLAB

Old course upto 2015

Course No :MAT502 **Number of Credits :6**

Semester – III Partial Differential Equations

Unit – I

Examples of Partial Differential Equations Classification of second order Partial Differential Equations. Transport equation – Initial value problem Non-homogeneous equations.

Laplace's equation- Fundamental solution, Poisson's equation, Mean value formulas, Properties of Harmonic functions, (15 lectures)

Unit – II

Laplace,s Equation,Strong maximum principle, Strong minimum principle, uniqueness, Regularity, Local estimates for harmonic functions Green's function, Derivation of Green's function, Green's function for half space, Green's function for a ball, Energy methods, uniqueness. (15 lectures)

Unit – III

Heat Equation-fundamental solution, Initial value problem, Non-homogenous problem,

Mean value formula, Properties of solutions, Strong maximum principle, uniqueness, Energy methods, uniqueness, Backwards uniqueness, Wave Equation – solution by spherical means, (15 lectures)

Unit – IV

Non-homogeneous equations, Energy methods. Nonlinear first Order PDE-Complete Integrals, envelopes, new solutions from envelopes characteristics, Representation of solutions-separation of variables, Similarity Solutions, Plane and Traveling waves, solutions, similarity under scaling, (15 lectures)

Unit – V

Transformation Methods Fourier and Lap lace Transform, Applications Converting Nonlinear into linear Partial Differential Equation cole-Hopf transformation, A parabolic Partial Differential Equation with quadratic no linearity Burger's equation with viscosity, Hodograph and Legendro Transforms, Potential function. (15 lectures)

Text Books:

1. Lawrence C. Evans: Partial Differential Equations, Graduate studies in Mathematics Vol. 19 AMS, 1998.
2. Ion N. Sneddon: Elements of Partial Differential Equations McGraw Hill, 1957.

Reference Books:

1) F. John: Partial differential Equation, Springer Verlag, (4th edition), 1995
2) P. Prasad & R. Ravindran: Partial differential Equations,