VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in

Mathematics

SYLLABUS

Master of Science/Social Science/Arts/etc…

(III Semester)

With effect from

2021-22

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Department of Mathematics

Jnana Sagara, Ballari - 583105

Distribution of Courses/Papers in Postgraduate Programme I to IV Semester as per Choice Based Credit System (CBCS) Proposed for PG Programs

III – SEMESTER

With Practical

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exam (Hrs)
				IA	SEE	Total	L	T	P		
THIRD	DSC11	21MAT3C11L	Mathematical Modeling	30	70	100	4	-	-	4	3
	DSC12	21MAT3C12L	Partial Differential Equations	30	70	100	4	-	-	4	3
	DSE1	21MAT3E1AL	Classical Mechanics	30	70	100	4	-	-	4	3
		21MAT3E1BL	Matrix computations								
		21MAT3E1CL	Operator Theory								
	DSE2	21MAT3E2AL	Computational Techniques	30	70	100	4	-	-	4	3
		21MAT3E2BL	Multi Variable Calculus								
		21MAT3E2CL	Probability and Statistics								
	GEC1	21MAT3G1AL	Mathematical Physics	20	30	50	2	-	-	2	1
		21MAT3G1BL	Mathematical Biology								
		21MAT3G1CL	Graph Theory (WITHIN FACULTY)								
	SEC3	21MAT3S3LP	Research Methodology	20	30	50	1	-	2	2	1
	DSC11P3	21MAT3C11P	Mathematical Modelling lab using R Programming	20	30	50	-	-	4	2	4
	DSC12P4	21MAT3C12P	Advanced Differential Equations lab using Python	20	30	50	-		4	2	4
Total Marks for III Semester						**600**				**24**	

Dept Name: Mathematics

Semester-III

DSC11: Mathematical Modeling

Course Title: MATHEMATICAL MODELING	Course code: 21MAT3C11L
Total Contact Hours: 52	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Deduce inferences from a given mathematical model.
2. understand physical systems through Mathematical models.
3. understand applications of differential equations, difference equations and graph theory in Mathematical modeling.

DSC11: Mathematical Modeling

Unit	Description	Hours
1	Ordinary differential equation – Linear growth model – Growth of science and scientists – Non-linear growth and decay models – Diffusion of glucose or a medicine in the bloodstream.	11
2	Modeling in population dynamics – Prey-predator models – Competition models – Multi-species models – Modeling of epidemics – Simple epidemic models – A model for diabetic-mellitus.	10
3	Modeling in second order O.D.E. – Modeling of planetary motion – Motion under central force – Circular motion – Elliptic motion of a satellites – Rectilinear motion.	10

4	Modeling through difference equations – Linear difference equation – Obtaining complementary function by use of matrices – Harrod model – cob-web model – Applications of Actuarial science.	10
5	Modeling through graphs – seven bridge problem – representing results of tournament – Genetic graph – Food web – Communication network – Matrices associated with a directed graph – Detection of clique – Terms of signed graph.	11

References:

1. J. N. Kapur, Mathematical Modeling, Wiley Eastern Limited, New Age International Pvt. Ltd., Reprint 2013.
2. J. N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East-West Press, New Delhi, 1985.
3. R. Olink, Mathematical Models in Social and Life Sciences, 1978.

Date Course Coordinator Subject Committee Chairperson

DSC12: Partial Differential Equations

Course Title: Partial Differential Equations	Course code: 21MAT3C12L
Total Contact Hours: 52	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Solve linear partial differential with different methods.
2. Understand the concept of second order partial differential equations like wave equation, heat equation, Laplace equations and their solutions by variable separable method, Laplace and Fourier transform methods.
3. Introduce some physical problems in Engineering and Biological models that results in partial differential equations.
4. Classify partial differential equations and transform into canonical form.
5. Solve linear partial differential equations of both first and second order.
6. Solve boundary value problem by Dirichlet and Neumann problem.

DSC12: Partial Differential Equations

Unit	Description	Hours
1	Linear and non-Linear First Order Partial Differential Equations: Introduction, Classification of first order , Solution of first order PDE: Lagaranges method, Integral surfaces passing through a given curve, surfaces orthogonal to a given system of surfaces. Non-linear PDE of first order: Charpits method , Compatible system of first order PDE, and their condition. Cauchy initial Value problem for first order PDE.	11
2	Second Order Partial Differential Equations: Introduction, Origin of Second Order Equations, Equations with Variable Coefficients and its different types. Classification of second order PDE in two independent variables, Reduction to its canonical form: method for reducing Parabolic, elliptic and Hyperbolic , equations to its Canonical	10

	Forms.	
3	Solutions of Elliptic, Parabolic and Hyperbolic PDEs: Introduction, Solutions by the methods of (i) Separation of Variables,(ii) Laplace Transformation and (iii) Fourier Transformation.	10
4	Solution of Wave equation, Diffusion equation and Laplace equation in cylindrical and spherical polar coordinates. Solution of wave equation, Diffusion equation and Laplace equation by Eigen function method.	10
5	Non-Linear PDE of second order: Introduction, Monge's method of integrating Rr+Ss+Tt =V by different types, (i) leads to two distinct intermediate integrals and both of them are used to get the desired solution (ii) leads to two distinct intermediate integrals and only one is employed to get the desired solution (iii) leads to two identical intermediate integrals,and (iv) fails to yield two identical intermediate integrals, illustrative through examples.	11

References:

1. Introduction to Partial Differential Equations, PHI Publications, 3 rd Edition K Sankar Rao, 2017.
2. Partial Differential Equations for Scientists and Engineers:, Dover Publications, Stanley J. Farlow, 1993.
3. An elementary course in Partial Differential Equations, 2nd Edition, Narosa Publishers, T Amaranath, 2013.
4. Elements of Partial Differential Equations, MCGrawhill publishers, I.N. Sneddon, 1957.
5. Ordianary and Partial Differential Equations, S Chand Publishers, 7th Ediation, M D Raisinghania, 2014
6. Partial Differential Eqaution, Aerical Matematical Society,2nd Edition, L C Ivans, 2010

Date Course Coordinator Subject Committee Chairperson

DSE1: (A) Classical Mechanics

Course Title: Classical Mechanics	Course code: 21MAT3E1AL
Total Contact Hours: 52	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO’s):

At the end of the course, students will be able to:

1. Explain physical significance of Navier’s equation.
2. Derive equation of motion of an elastic fluid.
3. Understand the Continuum Hypothesis.
4. Apply Fundamental basic physical laws in solving various problems.

DSE1: (A) Classical Mechanics

Unit	Description	Hours
1	Coordinate transformations, Cartesian tensors, Basic Properties, Transpose, Symmetric and Skew tensors, Isotropic tensors, Deviatoric Tensors, Gradient, Divergence and Curl in Tensor Calculus, Integral Theorems.	11
2	Continuum Hypothesis, Configuration of a continuum, Mass and density, Description of motion, Material and spatial coordinates, Translation, Rotation, Deformation of a surface element, Deformation of a volume element, Isochoric deformation, Stretch and Rotation, Decomposition of a deformation, Deformation gradient, Strain tensors, Infinitesimal strain, Compatibility relations , Principal strains.	10
3	Material and Local time derivatives Strain, rate tensor, Transport formulas, Stream lines, Path lines, Vorticity and Circulation, Stress components and Stress tensors, Normal and shear stresses, Principal stresses.	10
4	Fundamental basic physical laws, Law of conservation of mass, Principles of linear and angular momentum, Equations of linear elasticity, Generalized Hooke’s law in different forms, Physical meanings of elastic	10

	moduli, Navier's equation.	
5	Equations of fluid mechanics, Viscous and non-viscous fluids, Stress tensor for a nonviscous fluid, Euler's equations of motion, Equation of motion of an elastic fluid, Bernoulli's equations, Stress tensor for a viscous fluid, Navier-Stokes equation.	11

References:

1. D.S. Chandrasekharaiah and L. Debnath: Continuum Mechanics, Academic Press, 1994.
2. A.J.M. Spencer: Continuum Mechanics, Longman, 1980.
3. Goldstein, Classical Mechanics, Addison – Wesley, 3rd Edition, 2001.
4. F. Chorlton, Text Book of Dynamics, (ELBS Edition), G. Van Nostrand and co.(1969).

Date Course Coordinator Subject Committee Chairperson

DSE1: (B) Matrix Computations

Course Title: Matrix Computations	Course code: 21MAT3E1BL
Total Contact Hours: 52	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Decompose the matrix into its SVD.
2. Compute the low rank approximation of a given matrix.
3. Compute the FFT in 2D.
4. Gain knowledge of role of factorization of matrices.

DSE1: (B) Matrix Computations

Unit	Description	Hours
1	Multiplication Ax using columns of A, matrix-matrix multiplication. The four fundamental subspaces, orthogonal matrices and subspaces, eigen decomposition of symmetric positive definite matrices. Singular values and singular vectors in the SVD. Principal components and the best low rank matrix. Norms of vectors and functions and matrices. Factoring matrices and tensors.	11
2	Krylov subsapce and Arnoldi iteration, eigenvalues of tridiagonal T by the QR iteration, CG method, preconditioning. Least squares: four ways. Three bases for the column space, CMR factorization. An approximate SVD from the partial QR. Randomized linear algebra.	10
3	Changes in inverse of A from changes in A: perturbing any iterative matrix A, the derivative of inverse of A, the Kalman filter, Quasi-Newton update methods. Interlacing eigenvalues an low rank signals.The largest eigenvalue of S+T, saddle points from Lagrange multipliers.Rapidly	11

	decaying singular values. Split algorithms for l2+l1.	
4	Matrices for discrete Fourier transforms, fast Fourier transform.Eigenvalues and eigenvectors of a circulant matrices.Multiplication and convolution of functions.	10
5	The Kronecker product of matrices, two dimensional Fourier transforms. The Kronecker sum of matrices. Eigenvalues and eigenvectors of Kronecker product and sums of matrices.	10

References:

1. Gilbert Strang, Linear Algebra and Learning from Data, Wellesley-Cambridge Press, 2019.
2. Gene H. Goulab and Charles F. Van Loan, Matrix Computations,Hindustan Book Agency,2015.
3. Lloyd. N. Trefethen and David Bau, III, Society for industrial and applied Mathematics, 1997.
4. Ise C.F. Ipsen, Numerical Analysis, Society for industrial and applied Mathematics, 2009.

Date Course Coordinator Subject Committee Chairperson

DSE1: (C) Operator Theory

Course Title: Operator Theory	Course code: 21MAT3E1CL
Total Contact Hours: 52	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. To understand the concepts of spectral theory for bounded operators.
2. To understand the concepts of Banach algebras, culminating in the Gelfand-Naimark theorem.
3. To understand the behavior of linear operators and C $*$ -algebras of operators.
4. To understand the concept of compactoperators, Hilbert Schmidt operators

DSE1: (C) Operator Theory

Unit	Description	Hours
1	Operators on Hilbert spaces: self-adjoint, normal, unitary, isometry, partial isometry, projections, positive operators. Subnormal and hyponormal operators.	11
2	Spectral Results: Eigen spectrum and spectrum; spectral radius formula; spectral mapping theorem; spectrum of various operators on Hilbert space.	10
3	Finite rank operators, compact operators; Riesz-Schauder theory for compact operators; spectral theorem for compact self-adjoint and compact normal operators; singular value decomposition of compact operators; Trace class & Hilbert Schmidt operators.	11
4	Banach algebras, spectrum of a Banach algebra element, Holomorphic functional calculus, Gelfand theory of commutative Banach algebras.	10
5	***- Algebras**: Structure B*- Algebra and C* algerabs, A Charecterization of	10

	Banach C*-Algebras.	

References:

1. Daniel. Operator Theory, Springer 2015.
2. M. A. Bastos. Operator theory, Functional Analysis and Applications, Birkhluser Publication.
3. G. Bachman and L. Narici : Functional Analysis, Dover Publications 2012.
4. B.V.Limaye, Functional Analysis, New Age International Limited
5. S.K.Berbenon, Lectures in Functional Analysis and Operator Theory, Narosa, 1979.

Date Course Coordinator Subject Committee Chairperson

DSE2: (A) Computational Techniques

Course Title: Computational Techniques	Course code: 21MAT3E2AL
Total Contact Hours: 52	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understanding the theoretical and practical aspects of the use of numerical methods.
2. Implementing numerical methods for a variety of multidisciplinary applications.
3. Establishing the limitations, advantages, and disadvantages of numerical methods.
4. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.
5. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
6. Code various numerical methods in a modern computer language.

DSE2: (A) Computational Techniques

Unit	Description	Hours
1	Numerical Integration: Newton-cotes integration methods- Trapezoidal method, Simpson 1/3rd and 3/8th rule and Weddle rule. Gaussian integration methods and their analysis, Gauss-Legendre, Gauss-Hermite, Gauss-Lagurre and Gauss-Chebyshev integration methods and their analysis.	12
2	Numerical Solution of IVP for ordinary differential Equations: Initial Value problems- Taylors series method, Euler method, modified Euler method, Stability of 1st and 2nd order method ,Runge-Kutta methods (2nd and 4th order), R-K method for simultaneous and higher order differential equations.	10

3	Adam-Bashforth method, Milne predictor-Corrector methods, Finite difference method, Numerical solution of BVP for ODE- Shooting method, Collocation method , Galerkin method.	8
4	Numerical solution of Boundary value problems for PDE: Classification of partial differential equation, Derivation of finite difference approximations to its derivatives, solution of Laplace equation by Jacobi s method, Gauss Seidal method, Solution of heat equation by Schmidt method, Solution of wave equation by finite difference method.	10
5	Curve fitting, Regression Analysis: curve fitting, Regression analysis, inferences based on the least squares estimation, nonlinear regression, curve fitting by a sum of exponentials, fitting a straight line- second degree curve-exponential curve- power curve by method of least squares.	12

References:

1. Introductory methods of Numerical Analysis, PHI Publisher, 2012, S S Sastry,
2. Elementary Numerical Analysis, 3rd Edition, McGraw-Hill Book Company, S D Conte-Carle-de-Boor, 1980.
3. Elements of numerical Analysis, Cambridge University Press, R S Gupta, 2015.
4. Numerical Analysis, 9th edition,Cengage publisher, R L Burden, J D. Faires.2011.
5. Numerical Methods for Scientists and Engineers, PHI Publishers, K Sankara Rao, 2007.
6. Numerical methods for scientific and Engineering Computation, New Age International Publishers, M K Jain, S R K Iyengar and R K Jain, 2014.
7. Numerical Mathematical Analysis 6th Edition, Oxford and IBH publisher, J B Scarborough, 1984.
8. Numerical methods in Engineering and Science, Khanna Publishers,B S Grewal, 2013.

Date Course Coordinator Subject Committee Chairperson

DSE2: (B) Multi Variable Calculus

Course Title: Multi Variable Calculus	Course code: 21MAT3E2BL
Total Contact Hours: 52	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Apply mathematical concepts to construct the open, compact subsets etc. in the Euclidean space.
2. Write clear and precise proofs for some important theorems of vector valued functions.
3. Describe the properties involving of basic difference between series of functions and power series.
4. Able to digest advanced concepts in analysis.

DSE2: (B) Multi Variable Calculus

Unit	Description	Hours
1	The Stone Weierstrass theorem for approximation of continuous function. Illustration of theorem with examples. Properties of power series. Definition and properties of elementary functions: exponential and logarithmic function trigonometric functions.	11
2	Euclidean space R^n as a real vector space and a real inner vector space. Euclidean topology on R^n. Computation of interior, exterior and bounday points for some subsets of $R^{n.}$ Bolzano-Weierstrass property for subsets of R^n . Heine-Borel theorem for subsets of R^n.	10
3	Functions f: E → R^m from a subset E of R^n into R^m .Component functions. Limits, continuity and differentiation results with examples for vector valued functions. Implicit function theorem, rank theorem. Results on Jacobian.	10

4	Univalent functions, Hurwitz's Theorem and Normal Limits of Univalent Functions. Introduction to the Inverse Function Theorem, Completion of the Proof of the Inverse Function Theorem: The Integral Inversion Formula for the Inverse Function.	11
5	Univalent Analytic Functions have never-zero Derivatives and are Analytic Isomorphism's. Introduction to the Implicit Function. Proof of the Implicit Function Theorem: The Integral Formula for and analyticity of the Explicit Function.	10

References:

1. W.Rudin: Principles of mathematical analysis, 3rd edition, McGraw Hill Book Co. 1964.
2. S. C. Malik and S. Arora, Mathematical Analysis, 4th edition, New Age International Publications, 2012.
3. Complex Variables with Applications, by Saminathan Ponnusamy and Herb Silverman, Birkhaeuser, Boston, 2006.

Date Course Coordinator Subject Committee Chairperson

DSE2: (C) Probability and Statistics

Course Title: Probability and Statistics	Course code: 21MAT3E2CL
Total Contact Hours: 52	Course Credits: 04
Formative Assessment Marks: 30	Duration of ESA/Exam: 3 hours
Summative Assessment Marks: 70	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Solve problems related to probability.
2. Find the regression coefficients and the correlation coefficient from the two lines of regression.
3. Apply Baye's Theorem to solve real life problems.
4. Understands the importance of Normal distribution and Poisson distribution.

DSE2: (C) Probability and Statistics

Unit	Description	Hours
1	Theory of Probability: Introduction, Set theory, permutation and combination, classical probability, statistical probability, axiomatic probability, addition theorem of probability, theorem of compound probability, pair wise and mutual independence, inverse probability, Baye's Theorem.	10
2	Random variable, probability distribution of a discrete random variable, probability distribution of a continuous random variable, distribution function or cumulative probability function, moments, mathematical expectation, theorems on expectation, variance of X in terms of expectation, covariance in terms of expectation, variance of linear combination, Joint and marginal probability distributions	11
3	Theoretical distribution: Introduction, binomial distribution, probability function of binomial distribution, constants of binomial distribution, mode of binomial distribution, fitting of binomial distribution, Poisson	11

	distribution, importance of Poisson distribution, constants of Poisson distribution, mode of Poisson distribution, fitting of Poisson distribution, Normal distribution, equation of normal probability curve, standard Normal distribution, relation between Binomial and Normal distribution, relation between Poisson and Normal distribution, properties of Normal distribution, areas under standard Normal probability curve, importance of Normal distribution.	
4	Correlation Analysis: Types of Correlation, methods of studying Correlation, scatter diagram method, Covariance method, probable error, Correlation in bivariate frequency table, Rank Correlation method, method of concurrent deviations, coefficient of determination, lag and lead Correlation.	10
5	Linear Regression Analysis: Introduction, linear and non-linear regression, lines of regression, coefficients of regression, to find the mean values $(\bar{X}, \bar{Y})$ from the two lines of regression, to find the regression coefficients and the correlation coefficient from the two lines of regression, Standard error of an estimate, regression equations for a bivariate frequency table, correlation analysis vs regression analysis.	10

References:

1. S. C. Gupta, Fundamentals of statistics, Himalaya Publishing House, 7th revised edition, 2012.
2. V. Krishnamurthy, Combinatory, Theory and Applications, Affiliated East-West Press Pvt. Ltd.
3. C. L. Liu: Elements of discrete Mathematics, McGraw Hill, International (1986).
4. B. Kolman, R. C. Busby and S. Ross: Discrete Mathematical structures, Prentice Hall of India, New Delhi (1998).
5. J. P. Tremblay and R. Manohar: Discrete Mathematical structure with Applications to Computer Science, Tata McGraw Hill Edition(1997).
6. K. D. Joshi: Foundations of Discrete Mathematics, Wiley Eastern (1989).

Date Course Coordinator Subject Committee Chairperson

GEC1: (A) Mathematical Physics

Course Title: Mathematical Physics	Course code: 21MAT3G1AL
Total Contact Hours: 26	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 1 hours
Summative Assessment Marks: 30	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Apply Laplace transform and its linearity Property to solve differential equations.
2. Explain Functions of exponential order.
3. Apply the First shifting theorem, Change of scale property to solve the problems.
4. Apply finite and infinite Fourier transform to solve differential equation.
5. Explain properties of inverse transforms, Z-transforms, Meline transforms.

GEC1: (A) Mathematical Physics

Unit	Description	Hours
1	Laplace Transform: Integral Transform, Laplace Transform definitions, Linearity Property of Laplace Transform, Piecewise continues functions, existence of Laplace transforms, Functions of Exponential order, Function of class A, First shifting theorem, Second translation, Change of scale property and its examples, Periodic Functions, Some special functions.	15
2	Fourier Transforms: Finite and Infinite Fourier transforms, Fourier sine and cosine transforms, properties inverse transforms.Z-transforms.Meline transforms.	11

References:

1. Jon Mathews, Mathematical Method of physics.
2. Boas, Mathematical Method in physical sciences.

Date Course Coordinator Subject Committee Chairperson

GEC1: (B) Mathematical Biology

Course Title: Mathematical Biology	Course code: 21MAT3G1BL
Total Contact Hours: 26	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 1 hours
Summative Assessment Marks: 30	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand mathematical modeling and statistical methods in the analysis of biological systems.
2. Develop mathematical results in language understandable by biologists.
3. Formulate discrete and differential equation models that represent in a range of biological problems, including, identifying assumptions that are appropriate for the problem to be solved.
4. Explain Single-Species model in both Aged and non-aged structured.
5. Obtain the relationship between Eigen values and critical points.

GEC1: (B) Mathematical Biology

Unit	Description	Hours
1	Mathematical Modeling: Introduction, Some fundamental concepts, Mathematical modelling, Formation of a Mathematical model, Solution of a Mathematical Model, Interpretation of the solution, Types of Models, Limitations of Models, Areas of modeling. Some simple Mathematical Models.	12
2	Mathematical Aspects of Population Biology: Mathematical Modelling in Biology, Statility and Classification of Equilibrium points. Relationship between eigen values and critical points. Single- Species Models (Non-age structured): Exponential growth Model, Single-Species Models (Age Structurerd): Continus-Time Continuous-Age-Scale population Models, Introduction to some Basic concepts of Fluid	14

	Dynamics: Model for Blood flow-Formation.	

References:

1. James D Murray. Mathematical Biology, Springer, 2002.
2. Mathematics of Medicine and biology : J.G.Gefares ,I.N.Sneddon.
3. J. N. Kapur. Mathematical Models in Biology and Medicine, New Delhi, Affiliated East-West Press, 1985.
4. J.D. Logan & W.R.Wolesensky. Mathematical Methods in Biology, Publisher: John Wiley & Sons Inc..

Date Course Coordinator Subject Committee Chairperson

GEC1: (C) Graph Theory

Course Title: Graph Theory	Course code: 21MAT3G1CL
Total Contact Hours: 26	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 1 hours
Summative Assessment Marks: 30	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Examine whether the given graph is Euler graph or not.
2. To obtain Incidence Matrix, Adjacency Matrix of the Graph.
3. Find all spanning Tree of a Graph.
4. Acquires in-depth knowledge of Walks, Paths and Circuits.
5. Apply Algorithm to find shortest path between two specified vertices in a graph.

GEC1: (C) Graph Theory

Unit	Description	Hours
1	Introduction to Graphs, Subgraphs, Degree Sequences and Graphic Sequences, Walks, Paths and Circuits, Connected Graphs, Disconnected Graphs, Euler Graph, Hamiltonian Paths and Circuits, The Traveling Salesman Problem. Trees, Characterization of Trees, Distance and Centers in a Trees, Spanning Trees, Fundamental Circuits, Finding all Spanning Tree of a Graph.	13
2	Incidence Matrix, Adjacency Matrix, Circuit Matrix, Fundamental Circuit Matrix, An Application to a Switching Network. Some Basic Algorithms: Algorithm of Connectedness and Components, A Spanning Tree, A Set of Fundamental Circuits, Shortest Path From a Specifies Vertex to another Specifies Vertex.	13

References:

1. NarasingDeo: Graph Theory with Applications to Engineering and Computer Science, Prentice Hall, India (1995)
2. F. Harary: Graph Theory, Addison Wesley, Reading mass(1969)

3. F.Buckley and F. Harary: Distance in Graphs, Addison-Wesley (1990)
4. J. A. Bondy and V. S. R. Murthy: Graph Theory with Applications, MacMillan,
5. London.
6. S. Arumugam & S. Ramachandran. Invitation to Graph Theory, Scitech Publications (India) PVT. LTD, 2013.

Date Course Coordinator Subject Committee Chairperson

SEC3: Research Methodology

Course Title: Research Methodology	Course code: 21MAT3S3LP
Total Contact Hours: 39 (13L+ 26P)	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 1 hours
Summative Assessment Marks: 30	

Unit	Description	Hours
1	**Introduction to Research** Nature and importance of research- Aims, Objectives and Principles: Fundamental research vs. applied research with examples: Qualitative vs Quantitative research: Theoretical research vs. experimental research with examples: Selection of a research problem and Sources of literature – Journals, Conferences, Books. Types of sources: Literature Survey engines-Scopus, web of Science, Google Scholar, PubMed, NCBI, Scihub, etc. Science citation index: Citations, h-index, i10 index, impact factor.	7
2	**Methods of Data Collection** Data Collection Methods- Framing a hypothesis, designing controlled experiments, choosing the sample-size, sampling bias, importance of independent replicates, conducting an experiment, maintaining a lab-notebook to record observations: Identifying experimental errors. Case-studies on well-designed experiments vs. poorly designed experiments. Correlations vs. Causation .Good laboratory Practices. Safety practices in laboratories; Introduction to Chemdraw, Chemsketch and other basic softwares.	6
3	**Data analysis (Practical)** **Data Presentation and Writing:** Technical presentation, technical writing, Formatting citations ; MS Excel for plotting the data (pie chart, plots, bar charts) **Analysis using software tools:** Descriptive Statistics: Mean, standard deviation, variance, plotting data and understanding error-bars. Curve Fitting: Correlation and Regression.	26 (Lab)

	Distributions: Normal Distribution, Gaussian distributRion, skewed distributions. Inferential Statistics: Hypothesis testing and understanding p-value. Parametric tests: Student's t-test, ANOVA. Tests to analyse categorical data: Chi-square test.	

References (indicative)

1. C.R. Kothari, Research Methodology: Methods and Techniques, II Ed. New Age International Publishers, (2009).
2. Shanthibhushan Mishra, Shashi Alok, Handbook of Research Methodology, I Ed, 2017, Educreation Publishers.
3. Basic Statistical Tools in Research and Data Analysis (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5037948/).
4. Introduction to Statistical methods with MATLAB (MATLAB and Simulink Training (mathworks.com)

Date Course Coordinator Subject Committee Chairperson

DSC11P3: Mathematical Modeling Lab using R Program

Course Title: Mathematical Modeling Lab using R Program	Course code: 21MAT3C11P
Total Contact Hours: 52	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 4 hours
Summative Assessment Marks: 30	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Students will be able to model data using the language and techniques of mathematics
2. Understand the use of R for Big Data analytics.
3. Learn to apply R programming for Text processing.
4. Able to appreciate and apply the R programming from a statistical perspective.

DSC11P3: Mathematical Modeling Lab using R Program

Unit	Description	Hours
1	List of Programs: 1. Solving algebraic/transcendental equations by Newton-Raphson method. 2. Solving first order ordinary differential equation by Euler method. 3. Solving first order ordinary differential equation by Runge-Kutta method. 4. Solving first order ordinary differential equation by Adams-Bashforth-Moulton predictor-corrector method. 5. Analyze linear growth model by evaluating the stability of the points of equilibrium, displaying numerical solutions and graphical representation. Use Euler method. 6. Analyze Non-linear growth and decay models by evaluating the stability of the points of equilibrium, displaying numerical solutions and graphical representation. Use Runge-Kutta second order method. 7. Analyze Diffusion of glucose or a medicine in the bloodstream model by evaluating the stability of the points of equilibrium, displaying numerical solutions and graphical representation. Use Runge-Kutta third order method. 8. Analyze a Competition model by evaluating the stability of the points of	52

	equilibrium, displaying numerical solutions and graphical representation. Use Runge-Kutta forth order method. 9. Analyze a Multi-species model by evaluating the stability of the points of equilibrium, displaying numerical solutions and graphical representation. Use Runge-Kutta forth order method. 10. Analyze the model for diabetic-mellitus by Adams-Bashforth-Moulton method by evaluating the stability of the points of equilibrium, displaying numerical solutions and graphical representation. 11. Analyze epidemics models SIS, SIS with constant number of carriers, and SIS with removal and immigration by Adams-Bashforth-Moulton predictor-corrector method by evaluating the stability of the points of equilibrium, displaying numerical solutions and graphical representation. 12. Simulate the model $x_{t+1} = a + bx_t$ with suitable values of a, b and initial solution x_0. 13. Simulate logistic growth model $x_{t+1} = rx_t(1 - x_t)$.	

References (indicative):

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9. https://bookdown.org/aschmi11/RESMHandbook.

Date Course Coordinator Subject Committee Chairperson

DSC12P4: Advanced Differential Equations lab using Python

Course Title: Advanced Differential Equations lab using Python	Course code: 21MAT3C12P
Total Contact Hours: 52	Course Credits: 02
Formative Assessment Marks: 20	Duration of ESA/Exam: 4 hours
Summative Assessment Marks: 30	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Verify the important results learnt in differential equations on their own with the help of platform Python.
2. Compute solution of initial value problem using Runge-Kutta IV order Method.
3. Approximate the solution of a differential equation with initial condition by Picards method of successive approximation with the help of Python.
4. Develop Python code to find value of the function using Stirling Interpolation Method.

DSC12P4: Advanced Differential Equations lab using Python

Unit	Description	Hours
1	List of Programs: 1. Program to find the approximate solution of a differential equation with initial condition by Taylors series method. 2. Program to find the approximate solution of a differential equation with initial condition by Picards method of successive approximation. 3. Program to solve initial value problem using Euler Method. 4. Program to solve initial value problem using Modified Euler Method 5. Program to find solution of initial value problem using RungeKutta II order Method. 6. Program to find the solution of an initial value problem by Runge-Kutta III order method. 7. Program to find solution of initial value problem using Runge-Kutta IV order Method. 8. Program to find solution of initial value problem using Runge-Kutta - Fehlberg Method 9. Program to find solution of IVP using Runge-Kutta Method for system of equations 10. Program to find solution of initial value problem using Predictor-Corrector method.	52

	11. Program to find solution of initial value problem using Milne's Method. 12. Program to evaluate the given integral using Trapezoidal rule. Weddles rule 13. Program to evaluate the given integral using Simpson's 1/3 and 3/8th rule 14. Program to find value of the function using Lagrange Interpolation Method. 15. Program to find value of the function using Hermite Interpolation Method. 16. Program to find value of the function using Bessels Interpolation Method. 17. Program to find value of the function using Stirling Interpolation Method 18. Program to find the value of function using Newton Forward Difference Method. 19. Program to find the value of function using Newton Backward Difference Method. 20. Program to find the value of function using Newton divided differences 21. Program to find the boundary value problem of ODE by finite difference method. 22. Program to find the boundary value problem of ODE by Galerkin method. 23. Program to find the numerical solution of Laplace equation by Gauss-Seidal method. 24. Program to find the numerical solution of Laplace equation by Jacobis method . 25. Program to find the numerical solution of wave equation using Finite difference method 26. Program to find the numerical solution of Heat equation by Schmidt method. 27. Program to find the numerical solution of Heat equation by Crank-Nicolson method.	

References (indicative)

1. Gowrishankar S. Veena A -Introduction to Python Programming (2019).
2. Adam Stewart -Python Programming (2016).
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7. Introduction to Partial Differential Equations, PHI Publications, 3 rd Edition K Sankar Rao, 2017.

8. Partial Differential Equations for Scientists and Engineers:, Dover Publications, Stanley J. Farlow, 1993.
9. An elementary course in Partial Differential Equations, 2nd Edition, Narosa Publishers, T Amaranath, 2013.
10. Elements of Partial Differential Equations, MCGrawhill publishers, I.N. Sneddon, 1957.

Date Course Coordinator Subject Committee Chairperson