VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY
JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in Mathematics

SYLLABUS

Master of Science
(IV Semester)

With effect from
2021-22

Approved in BOS dated on 23.09.2022

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

IV-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	Sem. Exam	Total	L	T	P		
FOURTH	DSC13	21MAT4C13L	Functional Analysis	30	70	100	4	-	-	4	3
	DSC14	21MAT4C14L	Mathematical Methods	30	70	100	4	-	-	4	3
	DSE3	21MAT4E3AL	Advanced Fluid Mechanics/	30	70	100	4	-	-	4	3
		21MAT4E3BL	Applications of Numerical Linear Algebra/								
		21MAT4E3CL	Graph Theory								
	DSE4	21MAT4E4AL	Number Theory/	30	70	100	4	-	-	4	3
		21MAT4E4BL	Fuzzy Structures/								
		21MAT4E4CL	Operations Research								
	GEC2	21MAT4G2AL	Commercial Mathematics/	20	30	50	2	-	-	2	1
		21MAT4G2BL	Mathematical Statistics/								
		21MAT4G2CL	Mathematics for Social Sciences (OUTSIDE FACULTY)								
	DSC14P5	21MAT4C14P	Mathematical Methods using PYTHON	20	30	50	-	-	4	2	4
	Project	21MAT4C1R	Research Project	30	70	100		-	8	4	4
Total Marks for IV Semester						**600**				**24**	

Dept Name: Mathematics
Semester-IV
DSC13: Functional Analysis

Course Title: Functional Analysis	Course code: 21MAT4C13L
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. Understand the Open Mapping Theorem and its applications.
2. Obtain Orthogonal complements, Orthonormal sets and conjugate space.
3. Understand the relevance of Operator Theory.
4. Determine the spectrum of an operator.
5. Take up advance courses in analysis.

DSC13: Functional Analysis

Unit	Description	Hours
1	Normed linear Spaces. Banach Spaces : Definition and examples. Quotient Spaces. Convexity of the closed unit sphere of a Banach Space. Example of normed linear spaces which are not Banach space, .Holder's inequality. Minkowski's inequality. Linear transformations on a normed linear space and characterization of continuity of such transformations, Linear functional, The conjugate space N*.	11
2	The set $B(N, N')$ of all bounded linear transformations of a normed linear space N into normed linear space N' .The natural imbedding of N into N**. Reflexive spaces. Hahn - Banach theorem and its consequences, Projections on a Banach Space.The open mapping theorem and the closed graph theorem. The uniform boundedness theorem. The conjugate of an operator properties of conjugate operator.	12
3	Hilbert Spaces: Definition and Examples, Schwarz' s inequality. Parallelogram Law, polarization identity. Convex sets, a closed convex subset of a Hilbert Space contains a unique vector of the smallest norm. Orthogonal sets in a Hilbert space. Bessel' s inequality. orthogonal complements, complete orthonormal sets, Orthogonal decomposition of a Hilbert space.	10
4	Characterization of complete orthonormal set. Gram-Schmidt orthogonalization process The conjugate space H*of a Hilbert space H. Riesz Representation of a functional f as f(x)= (x, y) with y unique. The Hilbert space H*. Interpretation of T* as an operator on Self-adjoint operators.	10
5	Positive operators. Normal operators. Unitary operators and their properties. Projections on a Hilbert space, Invariant subspace. Orthogonality of projections. Eigen values and eigen space of an operator on a Hilbert Space. Spectrum of an operator on a finite dimensional Hilbert Space.	09
References:		

1. G. F. Simmons: Introduction to Topology and Modern Analysis (McGraw-Hill Intl. Edition) 2017.
2. S. Kumaresan & D. Sukumar. Functional Analysis: A First Course, Narosa Publication, 2020.
3. G. Backman and L. Narici : Functional Analysis, Dover Publications 2012.
4. B. V. Limaye : Functional Analysis, New Age International (P) Limited, Publishers, 2004..
5. W. Rudin. Introduction to Functional Analysis, McGraw-Hill 2017.
6. E. Kreyszig : Introduction to Functional Analysis with Applications, John Wiley & Sons 2007.

Date Course Coordinator Subject Committee Chairperson

DSC14: Mathematical Methods

Course Title: Mathematical Methods	Course code: 21MAT4C14L
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. Understand Green's function in reducing boundary value problems to integral equations.
2. Understanding Hilbert Schmidt theory
3. Derive functional and the construction of Euler's equation.
4. Understand variational methods for solving differential equations.
5. Analyze variational problems with moving boundaries.
6. Know methods of finding infinite Fourier transforms and Fourier integrals.
7. Apply Fourier, Laplace, Z and Mellin transform to solve the various physical problems.

DSC14: Mathematical Methods

Unit	Description	Hours
1	Integral Transforms: General definition of Integral transforms, Kernels, etc. Development of Fourier integral, Fourier transforms – inversion, illustration on the use of integral transforms, Laplace, Fourier, and Mellin transforms to solve ODEs and PDEs - typical examples. Z-transform, difference equations, definition, standard z-transform, linear property, damping rule, shifting rule, initial value theorem, inverse z-transforms, Application of z-transform to solve difference equations.	11
2	Volterra integral equations: Basic concepts, relationship between linear differential equations and Volterra integral equations - resolvent kernel of Volterra integral equations, solution of integral equations by resolvent kernel, the method of successive approximations, convolution type equations, solution of integro- differential equations with the aid of Laplace transformation.	10
3	Fredholm integral equations: Fredholm equations of the second kind, fundamentals, iterated kernels, constructing the resolvent kernel with the aid of iterated kernels, integral equations with degenerate kernels, characteristic numbers and eigenfunctions, solution of homogeneous integral equations with degenerate kernel, nonhomogeneous symmetric equations, Fredholm alternative. Reduction of IVPs BVPs and eigenvalue problems to integral equations. Hilbert Schmidt theorem.	11
4	Calculus of variations Variation of a functional, extremum of functional, variational problems, Euler's equation, standard variational problems including geodesis, minimal surface of revolution, hanging chain problems.	10
5	Perturbation methods: Introduction, Regular and singular perturbation methods: Parameter and co-ordinate perturbations. Regular perturbation solution of first and second order differential equations involving constant and variable coefficients.	10

References:

1. Advanced Mathematical methods for scientists and Engineers, Springer Publishers, 1999, C M Bender, S A Orszag, 1999.
2. Integral Transforms and their applications, Taylor and Franscis, L Debnath and D Bhatta, 2007.
3. Linear integral equations theory and techniques, Academic Press, New York, R.P. Kanwal: 1971.
4. Mathematical methods, Himalaya Publishing House, 1st Edition, V ravindranath and P Vijayalakshmi, 2012.
5. I.N. Sneddon – The use of Integral Transforms, Tata McGraw Hill, Publishing Company Ltd, New Delhi, 1974
6. R.P. Kanwal: Linear integral equations theory and techniques, Academic Press, New York, 1971.
7. Integral Equations, Shanthi, Krishna Publications, Swaroop and S R Singh,2014.
8. Integral Transforms Krishna Publishers, 34th Edition, A R Vasishtha and R K Gupta. 2015.
9. Perturbation methods, Wiley Publishers, A H Nayfeh 2004.

Date Course Coordinator Subject Committee Chairperson

DSE3: (A) Advanced Fluid Mechanics

Course Title: Advanced Fluid Mechanics	Course code: 21MAT4E3AL
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 Prandtl's boundary layer concept.
2. Determine velocity distribution in steady laminar flow of viscous incompressible fluid.
3. Derive Generalized plane Couette flow.
4. Illustrate Buckingham's pi-theorem & its applications.

DSE3: (A) Advanced Fluid Mechanics

Unit	Description	Hours
1	General theory of Stress and Rate of strain: Newton's law of viscosity, body and surface forces, Definitions of stress , stress vector and components of stress tensor, state of stress at a point, transformation of stress components, plane stress, principal stress and principal directions of the stress tensor, Nature of strain, Transformation of the rate of strain components, Stokes law of viscosity, The rate of strain quadric Translation, rotation and rate of deformation , and illustrative with applications.	11
2	The Navier Stokes equations of motion of a viscous fluid**,** The energy equation, equation of state for perfect fluid, diffusion of vorticity, equations of vorticity and circulation, dissipation of energy in Cartesian form, illustrative through examples. Vorticity transport equation, Diffusion of a vertex filament.	10
3	Dynamical similarity, Reynolds principle of similarity and its significance, inspection analysis in case of flow of viscous compressible fluid. Theory of similarity in heat transfer, / Physical significances of non- dimensional numbers, some dimensionless coefficients: Local skin friction, Lift and drag coefficient, Nusselt number, temperature recovery factor and illustrative through applications. Buckingham's pi-theorem & its applications.	11
4	Some exact solutions of Navier-Stokes equations: Determination of velocity distribution in steady laminar flow of viscous incompressible fluid: Plane Couette flow, Generalized plane Couette flow, plane Poiseuille flow, The Hagen Poiseuille flow, and flow between two co-axial circular cylinders.	10
5	Laminar Boundary Layers: Prandtl's boundary layer concept. Derivation of two dimensional boundary layer equation for velocity &temperature by order magnitude approach. Boundary layer thickness, Displacement thickness, Energy thickness, boundary layer flow past a fiat plate- Blasius solution.	10

References:

1. Text Book on Fluid Dynamics, CBS Publishers, F Chorlton, 2018.
2. Fluid Mechanics McGraw Hill Book Company, Walther Kaufmann , 1958.
3. An Introduction to Fluid Dynamics, Cambridge University press, G K Batchelor2009.
4. Boundary layer theory, Mc Graw Hill 7th Edition, H Schlichting, 2014.
5. Fluid Dynamics S Chand Publisher, 2nd Edition, M D Raisinghania, 2020.
6. Viscous Fluid Dynamics, Oxford and IBH Publishers, J L Bansal2004
7. Vectors, Tensors and the Basic equations of Fluid Mechanics, Dover Publishers, R Aris, 1990 .
8. A text Book of Fluid Mechanics and Hydraulic Mechanics, Laxmi Publications, R K Bansal,2018.
9. Fluid Dynamics Krishna Publishers, Shanthi Swaroop, 2020.
10. Fluid Mechanics, Khanna Publishers, Jain A K, 2998.
11. Physical and Computational Aspects of convective heat transfer, T cebeci and P Bradshaw, Springer Publisher, 1998.

Date Course Coordinator Subject Committee Chairperson

DSE3: (B) Applications of Numerical Linear Algebra

Course Title: Applications of Numerical Linear Algebra	Course code: 21MAT4E3BL
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. Understand the role of learning function in deep learning.
2. Understand the role of probability and optimization in deep learning.
3. Compute the minimization of loss function.
4. Compute the learn function from real world data.

DSE3: (B) Applications of Numerical Linear Algebra

Unit	Description	Hours
1	Sine and Cosine transforms from Kronecker sums, Toeplitz matrices and shift invariant filters, toeplitz eigenvalues and szego theorem, lowpass filter in signal processing, wavelet and inverse wavelet transform, graphs and Laplacians and Kirchoff's laws, clustering by spectral methods and k-means, four methods for clustering, the normalized Laplacian matrix,weights and the Kernel method. Application of clustering. Completing rank one matrices, distance matrices.	13
2	Mean and variance. Probability distribution and cumulative distribution.Covariance and joint probabilities. Normal distribution, central limit theorem. Binomial and uniform distribution.Markov and Chebyshev's inequalities. Weighted least squares and Kalman filter. Markov matrix and Markov chain.	12
3	Minimum problems: convexity and Newton's method, Leveberg-Marquardt for nonlinear least squares. Lagrange multipliers=derivative of the cost, dual problems. Linear programming.Gradient descent toward the minimum and illustration with example. Convergence analysis for steepest descent.Stochastic gradient descent and ADAM.	11
4	The loss function and the learning function, stocahastic descent using one sample per step. The functions of deep learning. Bias vs. Variance.	8
5	The construction of deep neural networks. The graph of learning function. Convolution neural networks. Neural nets to universal approximation.	8

References:

1. Gilbert Strang, Linear Algebra and learning from data, Wellesley-Cambridge Press, 2019.
2. Lloyd . N. Trefethen and David Bau, III, Society for industrial and applied Mathematics(SIAM), 1997.
3. Gilbert Strang, Linear algebra for everyone, Wellesley-Cambridge Press, 2020.

Date Course Coordinator Subject Committee Chairperson

DSE3: (C) Graph Theory

Course Title: Graph Theory	Course code: 21MAT4E3CL
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. Distingush between Planar and non-planar graphs
2. Understad the advance topics in graph theory.
3. Discuss the fundamental concepts of graph theory, with a sense of some of its modern applications.
4. Expalin the importance and uses of chromatic number.

DSE3: (C) Graph Theory

Unit	Description	Hours
1	**Factorization:** 1-factorization,2-factorization, decomposition and labeling of graphs, **Coverings:** Vertex covering, edge covering, independence number and matchings and matching polynomials.	12
2	**Planarity:** Planar graphs, outer planar graphs, Kuratowaski criterion for planarity and Eulers polyhedron formula. **Graph valued functions:** Line graphs, subdivision graph and total graphs.	10
3	**Colourings:** Chromatic numbers and chromatic polynomials.	8
4	**Spectra of Graphs:** Adjacency matrix, incidence matrix, characteristic polynomials, Eigen values, graph parameters, strongly regular graphs and Friendship Theorem.	10
5	**Groups and Graphs:** Automorphism group of a graph, operations on permutation graphs, the group of a composite graph. Topological indices and Adriatic indices of a various graphs.	12

References:

1. Diestel: Graph Theory, Springer-Verlag, Berlin.
2. F. Harary: Graph Theory, CRC Press (2018)
3. R. Gould: Graph Theory, The Benjamin/Cummings Publ. Co. Inc. Calif (1988)
4. O. Ore: Theory of Graphs, Amer-Maths. Soc. Collg. Publ. -38, providence (1962)
5. D. Cvetkovic, M.Doob and H. Sachs, Spectra in Graphs, Academic Press, New York (1980)
6. Tulasiraman and M.N.S.Swamy: Graphs, Networks and Algorithms, John Wiley (1989)
7. BelaBollobas, Modern Graph Theory, Springer (1998)

Date Course Coordinator Subject Committee Chairperson

DSE4: (A) Number Theory

Course Title: Number Theory	Course code: 21MAT4E4AL
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 division algorithm to find greatest common divisor, least common multiple and solve linear Diophantine equation.to find the prime factorisation of a number
2. Solve linear congruences, apply Chinese remainder theorem
3. Use the number theoretic functions in different fields of mathematics.
4. Solve quadratic congruences, to use Euler's criteria, Gauss lemma.
5. Solve non-linear congruences, to find the continued fraction expansion to rational numbers.

DSE4: (A) Number Theory

Unit	Description	Hours
1	Divisibility and Primes: Division algorithm, Greatest common divisor, Euclid's algorithm, LeastCommon Multiples, Linear Diophantine equations. Prime numbers, Prime-power factorisations,Distribution of primes, Fermat and Mersenne primes, Primality testing and factorization.	11
2	Congruences: Basic properties of congruences, Divisibility test with the congruence relation, Residue classes andcomplete residue systems, Linear congruences,Chinese Remainder theorem, Fermat's theorem, Reduced residue systems, the Euler-Fermattheorem, Wilson's theorem, Lagrange's theorem, Polynomial congruence mudulo m.	10
3	Number theoretic functions: Functions $\tau(n), \sigma(n)$, Euler-totient function (Phi-function), Mobius function, Mobius inversion formula, Mangoldt function $\Lambda(n)$, Liouville's function $\lambda(n)$. Properties of these functions.	10
4	Quadratic Congruence: Quadratic Residues and Quadratic non-residue, Legendre's symboland its properties, Euler's criterion, Gauss lemma, The quadratic reciprocity law and its applications.	10
5	Non-Linear Diophantine equations and continued fractions: Non-linear Diophantine equations $x^n + y^n = z^n,\ n \geq 2$, Pythagorean triple, Fermat's last equation, Simple continued fractions and their properties, Reccurring continued fraction, Symmetric continued fraction.	11

References:

1. Ajay Kr Chaudhuri, Introduction to Number Theory, New Central Book Agency (P) Ltd., Kolkata, 2012.
2. G. A. Jones and J. M. Jones, Elementary Number Theory, Springer UTM, 2007.
3. Tom M. Apostol, Introduction to Analytic Number Theory, Springer, 1989.
4. D. Burton, Elementary Number Theory, McGraw-Hill, 2005.

5. Niven, H.S. Zuckerman & H.L. Montgomery, Introduction to the Theory of Numbers, Wiley,2000.
6. H. Davenport, The Higher Arithmetic, Cambridge University Press, 2008.

Date Course Coordinator Subject Committee Chairperson

DSE4: (B) Fuzzy Structures

Course Title: Fuzzy Structures	Course code: 21MAT4E4BL
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. Identify fuzzy sets and perform set operations on fuzzy sets.
2. Understand fuzzy logic as a tool for quantifying uncertainty.
3. Know to include factors of uncertainty in modeling so as to derive realistic solutions.
4. Apply fuzzy logic in various real life situations such as decision making and inventory control.

DSE4: (B) Fuzzy Structures

Unit	Description	Hours
1	Fuzzy sets: Introduction, Crisp set, Fuzzy set, Types of Fuzzy sets, Characteristics and Significance of the Paradigm shift, Membership functions, Properties of a cuts, Standard operation of fuzzy sets, Fuzzy Complement, Fuzzy Union, Fuzzy Intersection, t- norms and t- conforms, Extension principle for fuzzy sets.	10
2	Fuzzy Relations: Crisp and fuzzy relations, Projections and cylindrical Extension, Binary fuzzy relations on a single set, Fuzzy equivalence relation, Fuzzy Compatibility relation, Fuzzy relation equations, Fuzzy Graphs, Similarity relation.	10
3	Fuzzy Numbers: Concept of fuzzy number, Operation of fuzzy number ,Triangular fuzzy number, other types of fuzzy number, Arithmetic operations on intervals, Arithmetic operations on fuzzy numbers, Lattice of fuzzy numbers, Fuzzy Equations.	10
4	Fuzzy Functions and Possibility Theory: Concept of fuzzy functions, Kinds of fuzzy function, Fuzzy extrema of function, Integration and Differentiation of fuzzy function, Probability and uncertainty, Random sets, Possibility measures: Measures of noncompactness, Fractal dimensions, Information measures, Possibility theory vs probability theory.	11
5	Fuzzy logic and Neural Nets: An overview of classical logic, Boolean algebra, Multivalued logics, Interval-valued fuzzy logic, Canonical forms, Notes on probabilistic logic, Fuzzy Propositions, Fuzzy Quantifiers, Linguistic Variables and hedges, Introduction to Neural Nets, Layered, Feedforward, Neural Nets, Fuzzy Neural Nets.	11

References:

1. James J. Buckley Esfandiar Eslami -An Introduction Fuzzy Logic and Fuzzy Sets- (2002).
2. H. Lee -First course on Fuzzy Theory and Applications, Springer- Verlag Berlin Heidelberg- Kwang (2005).
3. Hung T. Nguyen Elbert A. Walker -A First Course in Fuzzy Logic (2006)
4. Hung T. Nguyen, Nadipuram R. Prasad Carol L. Walker, Elbert A. Walker -A First

Course in Fuzzy and Neural Control- (2003).
5. Paul P Wang -Advances in Fuzzy Sets, Possibility Theory, and Applications- (2011).
6. Fuzzy sets and Fuzzy logic, Theory and Applications. By George J.Klor.and Yuan (1995).
7. Fuzzy sets uncertainty and information, By George J.Klir and Tina a. Fotger. (1994)
8. Kaufmann, A. P. Bonaert-Introduction to the Theory of Fuzzy subsets-vol-1: Fundamental Theoretical Elements.(1977) .

Date Course Coordinator Subject Committee Chairperson

DSE4: (C) Operations Research

Course Title: Operations Research	Course code: 21MAT4E4CL
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. Analyze the optimization methods and algorithms developed for solving various types of optimization problems and to formulate optimization problems.
2. Understand and apply the concept of optimality criteria for various types of optimization problems.
3. Solve various constrained and unconstrained problems in single variable as well as multivariable.
4. Apply the methods of optimization in real life situation.

DSE4: (C) Operations Research

Unit	Description	Hours
1	Introduction to Operations Research: Basic definitions, scope, objectives, phases, models and limitations of Operations Research. Linear Programming: Basic concepts, convex sets, open and closed half spaces, simplex, formulation of Linear Problem (LPP), feasible solution, basic feasible solution, optimal solution, graphical method, simplex method, big-M method, Duality in linear programming.	11
2	Transportation Problem (TP): Mathematical formulation, existence of feasible solutions, transportation table, initial basic feasible solution; North-west corner rule, row minima method, column minima method, matrix minima method, Vogel's Approximation Method (VAM).	11
3	Assignment Problem: Mathematical formulation, Hungarian Method for Solving Assignment Problem, Variations of the Assignment Problem-Multiple Optimal Solutions, Maximization Case in Assignment Problem, Unbalanced Assignment Problem, Restrictions on Assignment, routing problem, traveling salesman problem.	10
4	Networks: Network minimization, shortest route problem, shortest route algorithms for cyclic networks, maximal flow problem, Dijkstra's algorithm, Floyd's algorithm for finding shortest route in the network.	10
5	Integer Programming: Methods of integer programming problems; Cutting method, search method, mixed integer programming problem, Gomory's method, Branch and Bound Method.	10

References:

1. S.D. Sharma, Operations Research, KEDAR NATH Publishers.
2. Hamdy A. Taha Operations Research, Macmillam,(1989).
3. Kanti Swarup, P.K. Gupta and Mamohan, Operations Research, S. Chand & Sons, (1980).
4. S.Kalavathy, Operations Research, Vikas(2001).
5. G.Hadley, Linear Programming, Narosa Publishing House, New-Delhi,(1987).

Date Course Coordinator Subject Committee Chairperson

GEC2: (A) Commercial Mathematics

Course Title: Commercial Mathematics	Course code: 21MAT4G2AL
Total Contact Hours: 26	Course Credits: 02
Formative Assessment Marks: 15	Duration of ESA/Exam: 1 hours
Summative Assessment Marks: 35	

Course Outcomes (CO's):

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

1. Understand the basic concepts of general mental ability and logical reasoning skills.
2. Understands the mathematical concepts and concerned structures, and will be able to follow the patterns involved with mathematical reasoning.
3. Able to solve arithmetical problems like simplifications, average, percentage, probability, profit loss, simple interest, Data Interpretation Tabulation and graphs etc.

GEC2: (A) Commercial Mathematics

Unit	Description	Hours
1	General Mental Ability-I Series Completion, Coding and Decoding, Blood relations, Seating Arrangement, Comparison type questions. General Mental Ability-II Directions sense test, logical venn diagrams, data sufficiency.	13
2	Arithmetical Ability: Numbers, Simplification, Average, Problems on ages, Percentage, Probability. Profit and loss, ratio and proportion, time and work, simple interest compound interest. Data Interpretation Tabulation, Bar graphs, Pie charts, line graphs.	13

References:

1. Quantitative Aptitude by Dr. R S Aggarwal, Revised edition, ISBN 81-219-2498-7
2. A Modern Approach to Verbal Reasoning by Dr. R S Aggarwal, S. Chand and Company pvt. Ltd., ISBN 81-219-0552-4.
3. Fast Track Objective Arithmetic by Rajesh Verma Arihant Publishers ISBN: 9789312149836, 9789312149836.
4. Arithmetic Subjective and Objective For Competitive Examinations By R.S. Aggarwal (Revised Edition).
5. Objective Arithmetic: Numerical Ability Tests for Competitive Examinations by R. S. Aggarwal. S. Chand Limited, 1990.
6. Teach yourself Quantitative Aptitude by Arun Sharma.
7. The Pearson Guide To Quantitative Aptitude For Competitive Examination by Dinesh Kattar.

Date Course Coordinator Subject Committee Chairperson

GEC2: (B) Mathematical Statistics

Course Title: Mathematical Statistics	Course code: 21MAT4G2BL
Total Contact Hours: 26	Course Credits: 02
Formative Assessment Marks: 15	Duration of ESA/Exam: 1 hours
Summative Assessment Marks: 35	

Course Outcomes (CO's):

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

1. Acquire good knowledge and understanding in advanced areas of Mathematics and Statistics.
2. Collection the data and perform computation of various averages.
3. Find Measures of central tendency and dispersions of some problems.
4. Analyse the data by computing standard deviation and coefficient of variation.
5. Present the data in graphs and diagrams.

GEC2: (B) Mathematical Statistics

Unit	Description	Hours
1	Classification of Data:Objects and Functions, Types, Frequency Distribution- Ungroupedand Grouped series, Terms. Diagrams and Graphs: Diagrams - Meaning ,Utilities, Limitation, Construction, Types-one dimensional, Two- dimensional, others. Graphs- Meaning ,Utilities, Limitation, Construction, Types-Time series, Frequency Distribution-Histogram, Frequency polygon, Frequency curve and ogives, Terms.	13
2	Measures of Central Tendency: Introduction, Types of Averages, Arithmetic Mean- Simple and Weighted, Median and Mode, terms. Measures of Dispersions: Introduction, Range, Quartile Deviation, mean deviation, standard deviation and Coefficient of variation, terms. Correlation and Regression Analysis: Meaning Types- Probable Error.	13

References:

1. C.M.Chikkodi and B.G Satyaprasad, "Business Stastics", Himalaya Publishing House,(2005).
2. D. S. Chandrasekharaiah and L. Debnath, "Continuum Mechanics", Academic Press, (1994).
3. Probability and Statistics (Schaum's Outline Series)
4. Rao, A First Course In Probability And Statistics, Cambridge University Press, New delhi.
5. E. Rukmangadachar, Probability and Statistics Paperback – 2012, Pearsons education.

Date Course Coordinator Subject Committee Chairperson

GEC2: (C) Mathematics for Social Sciences

Course Title: Mathematics for Social Sciences	Course code: 21MAT4G2CL
Total Contact Hours: 26	Course Credits: 02
Formative Assessment Marks: 15	Duration of ESA/Exam: 1 hours
Summative Assessment Marks: 35	

Course Outcomes (CO's):

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

1. Formulate and develop mathematical arguments in a logical manner.
2. Apply derivative and integration rules while solving problems.
3. Understand, formulate and use quantitative models arising in Social science, Business and other contexts.
4. Solve sysyem of linear equations using Cramer's rule and inversion method.

GEC2: (C) Mathematics for Social Sciences

Unit	Description	Hours
1	Basics – exponents, polynomials, functions, limits, continuity, and derivatives Rules, integration, rules, economic applications. Optimisation – maxima and minima constrained, Lagrangian multiplier method first and second order conditions, solving numerical problems.	13
2	Linear algebra – vectors, matrix definition types relations and operations, trace, partitioned matrices, determinants, rank properties, inverse properties of inverse, solution to a system of linear equations, existence of uniqueness of solution, Cramer's rule, inversion method.	13

References:

1. Edward T. Dowling: Calculus for Business, Economics and Social Sciences, Schaum's Outline Series, TMH, 2005.
2. Edward T. Dowling: Introduction to Mathematical Economics, Tata McGraw Hills.
3. G.Hadley: Linear Algebra, Narosa Publishing House.
4. A.C.Chiang: Fundamental Methods of Mathematical Economics, McGraw-Hill.
5. Ismor Fischer: Basic Calculus Refresher, http://www.stat.wisc.edu/ ifischer/calculus.
6. Srinath Baruah : Basic Mathematics and its Applications in Economics, Macmillan.
7. Taro Yamane: Mathematics for Economists, Second ed., PHI.

Date Course Coordinator Subject Committee Chairperson

DSC14P5: Mathematical Methods using Python

Course Title: Mathematical Methods using Python	Course code: 21MAT4C14P
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 Poincare-Lindstedt method applied to Duffing's equation using Python.
2. Write a Python code to solve differential equations numerically.
3. Solve the singular perturbation problem and compare its solution with matched asymptotic expansion using Python .
4. Solve the Van der-Pol equation numerically.

DSC14P5: Mathematical Methods using Python

Unit	Description	Hours
1	**List of Programs:** 1. Program to find the value of integral equation as $x \to 0, \left(for\ ex: \int_0^1 \frac{\sin xt}{t} dx, \int_x^\infty \exp(-t^4) dt, \int_x^\infty t^{-1/2} \exp(-t) dt, and\ etc. \right)$ 2. Program to find the value of integral equation as, for example $\left(for\ ex: \int_x^\infty \frac{\cos t}{t} dt, \int_0^x \exp(t^2) dt, \int_0^x t^{-1/2} \exp(-t) dt, \frac{2}{\sqrt{\pi}} \int_0^x \exp(-t^2) dt\ as\ x \to \right.$ 3. Program to find the value of an integral equation as $x \to \infty$ and compare the leading order solution obtained by Laplace method $\left(for\ ex: \int_{-1}^1 \exp(-x \sin^4 t) dt, \int_0^{\pi/2} \exp(-x \tan t) dt, \int_0^\infty \exp(-x \sinh^2 t) dt, as\ x \to \right.$ 4. Program to compare the solution with the method of stationary phase $\left(for\ ex: \int_0^1 \cos(-x t^4) \tan t dt, \int_0^1 \cosh t^2 \exp(ixt^2) dt, \int_0^\infty \cos(xt - t^2) dt\ as\ x \to \right.$ 5. Program to verify Watson Lemma with numerical integration $\left(for\ ex: \int_0^5 \frac{\exp(-xt)}{1+t^2} dt, \int_1^\infty (s^2 - 1)^{-1/2} \exp(-xs) ds, \int_0^{\pi/2} \exp(-x \sin t) dt\ as\ x \to \right.$ 6. Program to verify the method of steepest descent. 7. Solve the differential equation numerically and compare the solution by regular perturbation method. 8. Program to solve the Van der-Pol equation numerically and compare its	52

	solution by regular perturbation method. 9. Program to solve the singular perturbation problem and compare its solution with matched asymptotic expansion. 10. Program to verify the Poincare-Lindstedt method applied to Duffing's equation. 11. Program to solve nonlinear first order differential equations and compare it with exact solution.	

References (indicative):

1. Allen Downey, Jeff Elkner, and Chris Meyers -Learning with Python.(2015)
2. C.H. Swaroop -A Byte of Python.(2013).
3. Eric Matthews -Python Crash Course.(2016).
4. Advanced Mathematical methods for scientists and Engineers, Springer Publishers, 1999, C M Bender, S A Orszag, 1999.
5. Integral Transforms and their applications, Taylor and Franscis, L Debnath and D Bhatta, 2007.
6. Linear integral equations theory and techniques, Academic Press, New York, R.P. Kanwal: 1971.
7. Mathematical methods, Himalaya Publishing House, 1st Edition, V ravindranath and P Vijayalakshmi, 2012.

Date Course Coordinator Subject Committee Chairperson

Project

Course Title: **Project**	Course code: 21MAT4C1R
Total Contact Hours: 52	Course Credits:04
Formative Assessment Marks: 30	Duration of ESA/Exam: 4 hours
Summative Assessment Marks: 70	

Course Outcomes (COs):

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

1. Conduct literature survey on specified area of research.
2. Define or state the research problem.
3. Analyze experimental observations by scientific methods.
4. Communicate (oral and written) the results of investigation

Date Course Coordinator Subject Committee Chairperson

CBCS Question Paper Pattern for PG Semester End Examination with Effect from the AY 2021-22

Disciplines Specific Core (DSC) and Discipline Specific Elective (DSE)

Paper Code: **Paper Title:**

Time: 3 Hours **Max. Marks: 70**

Note: Answer any *FIVE* of the following questions with Question No. 1 (Q1) Compulsory, each question carries equal marks.

Q1. 14 Marks

Q2. 14 Marks

Q3. 14 Marks

Q4. 14 Marks

Q5. 14 Marks

Note: Question No.1 to 5, *one question from each unit* i.e. (Unit I, Unit II, ….). The Questions may be a whole or it may consists of sub questions such as a,b, c etc…

Q6. 14 Marks

Note :Question No.6, *shall be from Unit II and III,* the Question may be a whole or it may consists of sub questions such as a,b, c etc…

Q7. 14 Marks

Note: Question No.7*, shall be from Unit IV and V*,the Question may be a whole or it may consists of sub questions such as a,b, c etc…

Q8. 14 Marks

Note: Question No-8 shall be from *Unit II, Unit III , Unit IV and Unit V*. The question shall have the following sub questions and weightage. i.e a – 05 marks, b – 05 marks, c – 04 marks.

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Skill Enhancement Courses (SECs)

Paper Code: **Paper Title:**

Time: 1 Hours **Max. Marks: 30**

There shall be Theory examinations of Multiple Choice Based Questions [MCQs] with Question Paper set of A, B, C and D Series at the end of each semester for SECs for the duration of One hour (First Fifteen Minutes for the Preparation of OMR and remaining Forty-Five Minutes for Answering thirty Questions). The Answer Paper is of OMR (Optical Mark Reader) Sheet.

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