

Vidyasagar Metropolitan College
Department of Mathematics

Programme Outcomes

1. To Develop Mathematical Reasoning
2. To understand The Fundamental Concepts & Its Applications
3. To Cultivate Computer Programming Skills in C & SageMath
4. To Acquire Problem Solving skills & Innovative Thinking
5. To Develop Interdisciplinary Knowledge
6. To Inculcate Awareness on Environment and Inclusive Growth
7. To Motivate Towards Higher Studies & Self-reliance

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Course Outcomes

Sem.	Paper Name	Course Outcome
1	CC-1: CALCULUS, GEOMETRY AND VECTOR ANALYSIS	<ul style="list-style-type: none"> ● UNDERSTAND THE CONCEPT OF HIGHER ORDER DERIVATIVES AND ITS APPLICATIONS ● UNDERSTAND THE CONCEPT OF REDUCTION FORMULAE IN INTEGRATION AND ITS APPLICATIONS ● APPLY CALCULUS IN BUSSINES, ECONOMICS AND LIFE SCIENCES ● COMPREHEND NUANCES OF TWO AND THREE-DIMENSIONAL GEOMETRY ● ANALYZE VARIOUS GEOMETRICAL OBJECTS AND THEIR EQUATIONS AND PROPERTIES ● UNDERSTAND VECTOR TRIPLE PRODUCT AND VECTOR EQUATIONS & ITS APPLICATIONS ● COMPREHEND DIFFERENTIATION AND INTEGRATION OF VECTOR FUNCTIONS OF ONE VARIABLE
1	CC-2 : ALGEBRA	<ul style="list-style-type: none"> ● DIFFERENT FUNCTIONS OF COMPLEX VARIABLE. ● IDEA AND CONCEPT OF DE MOIVRE'S THEOREM. ● BASIC CONCEPT OF THEORY OF EQUATIONS. ● METHODS OF SOLUTION OF CUBIC AND BIQUADRATIC EQUATIONS. ● PROBLEM SOLVING TECHNIQUE OF INEQUALITIES AND DIFFERENCE EQUATIONS. ● IDEA OF NUMBER THEORY RELATION AND MAPPING. ● DETERMINATION OF RANK OF A MATRIX AND ITS APPLICATION TO SOLVE A SYSTEM OF LINEAR EQUATIONS.
2	CC-3 : REAL ANALYSIS	<ul style="list-style-type: none"> ● INTUITIVE IDEA OF REAL NUMBERS. ● BASIC CONCEPTS OF SET THEORY. ● KNOWLEDGE OF SEQUENCE AND INFINITE SERIES. ● APPLICATION OF BOLZANO - WEIRSTRASS THEOREM. ● DIFFERENT TESTS FOR CONVERGENCE OF INFINITE SERIES. ● STUDY THE CONVERGENCE OF SEQUENCES THROUGH PLOTTING

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2	CC-4 : GROUP THEORY-I	<ul style="list-style-type: none"> ● CONCEPT OF BINARY OPERATION ● GROUP AND SUBGROUP: DEFINITION , BASIC PROPERTIES AND EXAMPLE OF GROUP AND SUBGROUP ● IDEA OF NORMALIZER, CENTRALIZER AND CENTER OF GROUP ● DEFINITION, EXAMPLES AND BASIC PROPERTIES OF CYCLIC GROUP ● PERMUTATION ON FINITE SET AND PERMUTATION GROUP ● LAGRANGE THEOREMS AND SOME OF ITS APPLICATION ● NORMAL SUBGROUP AND QUOTIENT GROUP OF A GROUP ● GROUP HOMOMORPHISM AND ISOMORPHISM OF GROUP AND DIFFERENT ISOMORPHISM THEOREMS, CAYLEY THEOREM
3	CC5 - THEORY OF REAL FUNCTIONS	<ul style="list-style-type: none"> ● CONCEPT AND IDEA OF CONTINUITY AND DIFFERENTIATION ● DIFFERENT TYPES OF DISCONTINUITIES OF FUNCTIONS. ● UNIFORM DISCONTINUITY AND ITS ANALYSIS. ● DIFFERENTIABILITY OF FUNCTION. ● MEAN VALUE THEOREMS AND ITS APPLICATIONS. ● APPLICATIONS OF MAXIMA AND MINIMA IN GEOMETRICAL PROBLEMS.
3	CC7- ODE AND MULTIVARIATE CALCULUS-I	<ul style="list-style-type: none"> ● FIRST ORDER ORDINARY DIFFERENTIAL EQUATION ● EXACT DIFFERENTIAL EQUATION AND INTEGRATING FACTORS ● PICARD'S EXISTENCE AND UNIQUENESS THEOREM ● LINEAR EQUATION AND EQUATION REDUCIBLE TO LINEAR EQUATION ● 1ST ORDER HIGHER DEGREE EQUATION, CLAIRAUT EQUATION AND SINGULAR SOLUTION ● LINEAR DIFFERENTIAL EQUATION OF 2ND ORDER: ● METHOD OF VARIATION OF PARAMETERS AND METHOD OF UNDERMINED CO-EFFICIENTS ● SYSTEM OF LINEAR DIFFERENTIAL EQUATIONS AND DIFFERENTIAL OPERATOR ● POWER SERIES SOLUTION OF DIFFERENTIAL EQUATION

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3	CC6 - RING THEORY AND LINEAR ALGEBRA-I	<ul style="list-style-type: none"> ● STUDY THE CONCEPT ON RING, SUBRING, INTEGRAL DOMAIN, FIELD, SUBFIELD ETC. ● LEARN HOW THE CONCEPT OF HOMOMORPHISM EXTENDED FROM GROUP THEORY TO RING THEORY WITH SOME GENERALISED PROPERTIES ● READ IDEAL THEORY OF RING IN DETAILS ● STUDY CORRESPONDENCE THEOREM AND FIND ONE-ONE CORRESPONDENCE BETWEEN THESET OF IDEALS AND THE SET OF ALL CONGRUENCES ON A RING. ● LEARN VECTOR SPACES OVER A FIELD AND ITS SUBSPACES WITH SOME PROPERTIES ● COMPUTE LINEAR COMBINATION, LINEAR SPAN, LINEAR INDEPENDENCE, LINEAR INDEPENDENCE OF VECTORS AND USE THEM TO FIND BASIS AND DIMENSION OF A VECTOR SPACE AND UNDERSTAND HOW TO CHANGE THE BASIS ● STUDY LINEAR TRANSFORMATIONS AND COMPUTE KERNEL, RANGE AND INVERSE LINEAR TRANSFORMATIONS ● FIND MATRICES OF LINEAR TRANSFORMATIONS. ● FIND CHARACTERISTIC EQUATION, EIGENVALUES, EIGENVECTORS OF A MATRIX ● LEARN CAYLEY-HAMILTON THEOREM AND ITS USE IN FINDING THE INVERSE OF A MATRIX
3	SEC A - C PROGRAMMING LANGUAGE	<ul style="list-style-type: none"> ● OVERVIEW OF COMPUTERS AND IMPORTANCE OF C LANGUAGE. ● DATA TYPES OF C AND DIFFERENT TYPES OF OPERATORS. ● IDEA OF DECISION MAKING IN C. ● CONCEPT OF VARIOUS CONTROL STATEMENTS. ● DETAIL ANALYSIS OF ARRAYS AND FUNCTIONS. ● BASIC CONCEPT OF LIBRARY FUNCTIONS
4	CC-8 - RIEMANN INTEGRATION AND SERIES OF FUNCTIONS	<ul style="list-style-type: none"> ● LEARN ABOUT PARTITION AND REFINEMENT OF PARTITION OF A CLOSED AND BOUNDED INTERVAL ● COMPUTE UPPER DARBOUX SUM $U(P, F)$, LOWER DARBOUX SUM $L(P, F)$, UPPER INTEGRAL, LOWER INTEGRALAND STUDY ASSOCIATED RESULTS. ● STUDY RIEMANN INTEGRABILITY IN DETAILS SO THAT STUDENTS CAN RECOGNIZE WHETHER A FUNCTION IS INTEGRABLE OR NOT ● STUDY DEFINITION AND PROPERTIES OF NEGLIGIBLE SET ALONG WITH SEVERAL EXAMPLES AND FIND IT CONNECTION WITH RIEMANN INTEGRABILITY ● UNDERSTAND THE FUNDAMENTAL THEOREM OF INTEGRAL CALCULUS & FIRST MEANVALUE

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		<p>THEOREM OF INTEGRAL CALCULUS.</p> <ul style="list-style-type: none"> ● DEVELOP THE IDEAS OF IMPROPER INTEGRATIONS AND LEARN HOW TO FIND THE VALUES OF IMPROPER INTEGRAL ● GAIN THE IDEA TO TEST A FUNCTION WHETHER IT IS CONVERGENCE OR NOT. ● STUDY CONVERGENCE AND WORKING KNOWLEDGE OF BETA-FUNCTION, GAMMA-FUNCTIONS AND THEIR INTERRELATION; USE THESE TO COMPUTE SOME INTEGRALS ● LEARN ABOUT POINTWISE AND UNIFORM CONVERGENCE. ● STUDY UNIFORM CONVERGENCE IN DETAILS FOR SEQUENCE AND SERIES OF FUNCTIONS. ● DEVELOP THE CONCEPT OF POWER SERIES AND STUDY ITS CONVERGENCE. ● LEARN WHEN AND HOW A FUNCTION CAN BE EXPRESSED AS POWER SERIES. ● KNOW ABOUT TRIGONOMETRIC SERIES AND THE STATEMENT OF SUFFICIENT CONDITION FOR A TRIGONOMETRIC SERIES TO BE A FOURIER SERIES. ● COMPUTE FOURIER SERIES EXPANSION OF SEVERAL FUNCTIONS
4	CC-9 - PDE AND MULTIVARIATE CALCULUS-II	<ul style="list-style-type: none"> ● FIRST ORDER PARTIAL DIFFERENTIAL EQUATIONS: FORMATIONS , SOLUTION ● DERIVATION AND SOLUTION OF HEAT EQUATION, WAVE EQUATION, LAPLACE EQUATION ● CAUCHY PROBLEM : STUDY AND SOLUTION ● MULTIPLE INTEGRAL AND RELATED TOPICS ● VECTOR FIELD AND ITS APPLICATIONS ● GREENS THEOREM, STOKES THEOREM & DIVERGENCE THEOREM AND APPLICATIONS
4	CC-10 - MECHANICS	<ul style="list-style-type: none"> ● UNDERSTAND THE CONCEPTS OF STATICS AND ITS APPLICATION. ● ANALYSE THE DIFFERENCE BETWEEN STATICS AND DYNAMICS. ● APPLICATION OF DYNAMICAL SYSTEM: ECOLOGY, MEDICAL SCIENCE, METEOROLOGY. ● KNOWLEDGE OF DYNAMICS IN PHYSICAL CULTURE. ● STUDY OF STATIC SYSTEM IN REAL LIFE. ● APPLY STATIC SYSTEM IN LIGHTNING, ELECTRIC CHARGES ON AN OBJECT, CAR RESTING ON A BRIDGE ETC

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4	SEC-B : SCIENTIFIC COMPUTING WITH SAGEMATH	<ul style="list-style-type: none"> ● INSTALLATION OF SAGEMATH SOFTWARE ● USE OF SAGEMATH AS A CALCULATOR ● MATRIX OPERATION USING SAGEMATH, SOLUTION OF SYSTEM OF EQUATION BY MATRIX METHOD ● INTEGRATION AND DIFFERENTIATION OF FUNCTION USING SAGEMATH ● SOLUTION OF DIFFERENTIAL EQUATION, BOUNDARY VALUE PROBLEM ● GRAPHICAL REPRESENTATION OF FUNCTIONS, SECANT, TANGENT AND ASYMYTOTES OF A CURVE ● USE OF INBUILT FUNCTION FOR CALCULATING AVERAGE, MEAN, MEDIAN AND MODE, GCD LCM, FACTORIAL ● USE OF SAGEMATH FOR CHECKING PRIME, CHECKING NEXT PRIME AND CONVERGENCE OF SEQUENCE
5	CC-11 : PROBABILITY AND STATISTICS	<ul style="list-style-type: none"> ● BASIC CONCEPTS OF PROBABILITY ● EVOLUTION OF PROBABILITY : FROM CLASSICAL TO MODERN ● PROBABILITY IN ONE VARIABLE & TWO VARIABLES ● CONVERGENCE IN PROBABILITY ● SAMPLING & SAMPLING DISTRIBUTION ● ESTIMATION OF PARAMETERS ● STATISTICAL HYPOTHESIS
5	CC-12: GROUP THEORY-II AND LINEAR ALGEBRA-II	<ul style="list-style-type: none"> ● AUTOMORPHISM GROUP OF FINITE AND INFINITE CYCLIC GROUP. ● IDEA OF EXTERNAL AND INTERNAL DIRECT PRODUCT. ● APPLICATIONS OF FACTOR GROUPS TO AUTOMORPHISM GROUP. ● CONCEPT OF INNER PRODUCT SPACE. ● ORTONORMALISATION PROCESS RELATED PROBLEMS. ● CONCEPT OF BILINEAR AND QUADRATIC FORMS. ● PROBLEMS BASED ON DUAL SPACE AND DUAL BASIS.
5	DSE - A1: ADVANCED ALGEBRA	<ul style="list-style-type: none"> ● GROUP ACTION AND APPLICATION OF GROUP ACTION ● GENERALISED CAYLEYS THEOREM AND INDEX THEOREM ● CLASS EQUATION AND ITS CONSEQUENCES ● SYLOWS THEOREM AND P-GROUP ● PRINCIPAL IDEAL DOMAIN: PRIME, IRREDUCIBLE ELEMENTS, GCD AND LCM OF TWO ELEMENTS IN A DOMAIN ● UNIQUE FACTORIZATION DOMAIN AND ITS RESULTS

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		<ul style="list-style-type: none"> ● EUCLIDEAN DOMAIN AND RELATION BETWEEN PRINCIPAL IDEAL DOMAIN, UNIQUE FACTORIZATION AND EUCLIDEAN DOMAIN. ● POLYNOMIAL RING: DIVISION ALGORITHM, FACTORIZATION OF POLYNOMIAL, EISENSTEIN CRITERIA AND FACTORIZATION IN $\mathbb{Z}[X]$ ● RING EMBEDDING AND QUOTIENT FIELD ● REGULAR RING
5	DSE - B1: LINEAR ALGEBRA & GAME THEORY	<ul style="list-style-type: none"> ● KNOWLEDGE OF LINEAR PROGRAMMING PROBLEM IN DAILY LIFE. ● BASIC CONCEPTS OF HYPERPLANE, CONVEX SETS ETC. ● MODELLING: FORMULATION OF LPP IN REAL LIFE. ● JUSTIFICATION FOR OPTIMALITY CRITERION. ● CONCEPTS OF GAME PROBLEM. ● LPP IN OPERATIONAL RESEARCH
6	CC-14 : NUMERICAL METHODS	<ul style="list-style-type: none"> ● BASIC KNOWLEDGE OF NUMERICAL SOLUTION OF INTEGRATION BY DIFFERENT METHODS. ● APPLICATION OF NUMERICAL ANALYSIS: ORDINARY DIFFERENTIAL EQUATION, SOLUTION OF TRANSCENDENTAL EQUATION ETC. ● STUDY AND SOLUTION OF INTERPOLATION IN DIFFERENT ZONE. ● KNOWLEDGE OF ERRORS AND APPROXIMATION. ● CALCULATIONS: BY PROGRAMMING USING C, FORTRAN 77 , MATLAB ETC. ● MOTIVATED ON RESEARCH TOPICS: MATHEMATICAL OPTIMIZATION, DIFFERENTIAL EQUATION ETC.
6	CC-13 : METRIC SPACE AND COMPLEX ANALYSIS	<ul style="list-style-type: none"> ● GENERALIZE THE NOTION OF DISTANCE TO DEFINE A METRIC & METRIC SPACE AND USE IT TO GENERALISE THE BASIC CONCEPTS OF REAL ANALYSIS. ● LEARN ABOUT CONVERGENCES OF SEQUENCE, CANTORS THEOREM, COMPACTNESS, HEIN-BOREL THEOREM, FINITE INTERSECTION PROPERTY, CONTINUOUS FUNCTION, CONTRACTION MAPPING, BANACH FIXED POINT THEOREM AND ITS APPLICATION ETC. IN A GENERALISED FORM. ● STUDY THE BASIC CONCEPTS AND FUNDAMENTAL DEFINITIONS UNDERLYING COMPLEX ANALYSIS. ● LEARN ABOUT STEREOGRAPHIC PROJECTION, REGIONS, LIMITS, CONTINUITY, FUNCTIONS OF COMPLEX VARIABLES, DERIVATIVES, DIFFERENTIATION FORMULAS, CAUCHY-RIEMANN EQUATIONS, ANALYTIC FUNCTIONS AND SOME SPECIAL FUNCTIONS.

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		<ul style="list-style-type: none"> ● STUDY ABOUT THE CONCEPTS OF POWER SERIES, CONTOURS, INTEGRATION OF COMPLEX FUNCTIONS AND SEVERAL THEOREMS ON THAT.
6	CC-14 PRACTICAL : NUMERICAL METHODS LAB	
6	DSE - A2:MATHEMATIC AL MODELLING	<ul style="list-style-type: none"> ● POWER SERIES SOLUTION OF BESSELS EQUATION AND LEGENDRES EQUATION ● LAPLACE TRANSFORM AND APPLICATIONS ● MONTE CARLO SIMULATION MODELLING : A FEW APPLICATIONS ● OPTIMIZATION MODELLING ● LINEAR PROGRAMMING MODELLING: A FEW APPLICATIONS
6	DSE - B2: POINTSET TOPOLOGY	<ul style="list-style-type: none"> ● TOPOLOGICAL SPACES: SOME BASIC PROPERTIES AND ITS EXAMPLE ● BASES, SUB-BASE AND SUBSPACE TOPOLOGY ● INTERIOR POINT, BOUNDARY POINT, LIMITS POINT OF A SET IN A TOPOLOGICAL SPACE. OPEN SET AND CLOSED SET AND CLOSURE OF A SET ● PRODUCT TOPOLOGY AND METRIC TOPOLOGY ● OPEN MAP, CLOSED MAP, CONTINUOUS MAP AND HOMEOMORPHISM ● SEPARATION AXIOM: FIRST COUNTABILITY, SEPARATION AXIOMS ● CONCEPT OF CONVERGENCE AND CLUSTER POINT FIRST COUNTABLE AND SPACE. ● CONNECTED AND COMPACT METRIC SPACE. CONNECTED SUBSET OF R AND COMPONENTS. COMPACTNESS IN SPACE AND R. HEINE-BOREL THEOREM IN ● REAL VALUED CONTINUOUS FUNCTION IN CONNECTED AND COMPACT SPACE ● SEQUENTIAL COMPACTNESS OF METRIC SPACE

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Mapping/Co-relation Program Outcome(PO) & Course Outcome(CO)

Department : Mathematics Academic Session : 2022-23								
CO Details		PO Details						
SI No.	Course Name	PO1 (To Develop Mathematical Reasoning)	PO2 (To understand The Fundamental Concepts & Its Applications)	PO3 (To Cultivate Computer Programming Skills in C & SageMath)	PO4 (To Acquire Problem Solving skills & Innovative Thinking)	PO5 (To Develop Interdisciplinary Knowledge)	PO6 (To Inculcate Awareness on Environment and Inclusive Growth)	PO7 (To Motivate Towards Higher Studies & Self-reliance)
1	CC-1: CALCULUS, GEOMETRY AND VECTOR ANALYSIS	✓	✓		✓	✓		✓
2	CC-2 : ALGEBRA	✓		✓	✓			✓
3	CC-3 : REAL ANALYSIS	✓	✓	✓				✓
4	CC-4 : GROUP THEORY-I	✓	✓	✓			✓	✓
5	CC5 - THEORY OF REAL FUNCTIONS	✓			✓	✓		✓

6	CC6 - RING THEORY AND LINEAR ALGEBRA-I	✓	✓		✓	✓		✓
7	CC7- ODE AND MULTIVARIATE CALCULUS-I	✓	✓	✓	✓	✓	✓	✓
8	SEC A - C PROGRAMMING LANGUAGE	✓				✓		✓
9	CC-8 - RIEMANN INTEGRATION AND SERIES OF FUNCTIONS	✓	✓		✓	✓		✓
10	CC-9 - PDE AND MULTIVARIATE CALCULUS-II	✓	✓		✓	✓	✓	✓
11	CC-10 - MECHANICS	✓	✓		✓			✓
12	SEC-B : SCIENTIFIC COMPUTING WITH SAGEMATH	✓	✓	✓		✓		✓
13	CC-11 : PROBABILITY AND STATISTICS	✓	✓	✓	✓	✓	✓	✓

14	CC-12: GROUP THEORY-II AND LINEAR ALGEBRA-II	✓	✓		✓	✓	✓	✓
15	DSE - A1: ADVANCED ALGEBRA	✓		✓		✓	✓	✓
16	DSE - B1: LINEAR ALGEBRA & GAME THEORY	✓		✓	✓	✓	✓	✓
17	CC-13 : METRIC SPACE AND COMPLEX ANALYSIS	✓	✓		✓	✓		✓
18	CC-14 : NUMERICAL METHODS	✓		✓	✓	✓		✓
19	CC-14 PRACTICAL : NUMERICAL METHODS LAB	✓		✓	✓	✓		
20	DSE - A2:MATHEMATICAL MODELLING	✓	✓		✓	✓		✓
21	DSE - B2: POINTSET TOPOLOGY	✓	✓	✓	✓	✓		✓