Department:Mathematics

The CBCS Course curriculum is well designed and very promising where the core course wouldhelptoenrichthesubjectknowledgeofthestudentsandgenericelectivesmakeintegrationamongvarious interdisciplinary coursers. The introduction of Skill Enhancement Courses (SEC) andDisciplineSpecificCourses(DSE)wouldhelpto gainmorepowerfulknowledgenotonlyintheircoreMathematicssubjectbutalsoininterrelatedmultidisciplinarysubjectsandalsohelpsthemtobecomefamiliarandexpertinhandlingdifferentmathematics-basedsoftwareafterpropertraining.Inbriefthestudentgraduatedwiththistypeofcurriculumwouldbabletoaccumulatethesubjectknowledgealongwiththenecessaryskillstosufficetheircapabilitiesforacademia,entrepreneurshipand industry.

ProgramOutcomes:

- Studentswillbeableto understand thefoundationsofmathematics.
- Studentswill beable to performbasiccomputationsin highermathematics.
- Studentswillbeabletoread andunderstand middle-levelproofs.
- Studentswill beable to writeand understand basicproofs ofMathematics.
- Studentswillbe ableto develop andmaintain problem-solvingskills.
- Studentswillusemathematicalideastomodelreal-worldproblems.
- Studentswillbeabletocommunicatemathematicalideaswithothers.
- Studentshaveexperienceusingtechnologytoaddressmathematicalideas
- Studentswilldemonstratetheabilitytocommunicatemathematicalideasclearly.Theywillusecorrect mathematicalterminology andpropermathematical notation.

ProgramSpecificOutcomes:

- Students will be able to write detailed solutions using appropriate mathematical language.Students will be able to identify areas in mathematics and other fields where Calculus isuseful.
- studentscansimplifyormanipulateexpressionsinvolvingpolynomial,rational,exponential,or logarithmic termsusing appropriatepropertiesand rules.
- Studentswillbeabletoexpresstheexistence-uniquenesstheoremofdifferentialequations,to solve first-order ordinary differential equations & solve exact differential equations.They are able to convert separable and homogeneous equations to exact differentialequationsby integratingfactors.
- studentswillbeabletouseknowledgeofpartialdifferential equations(PDEs),modelling,the general structure of solutions, and analytic and numerical methods for solutions.formulatephysical problems as PDEs using conservation laws.
- Students will learn to visualize and manipulate multivariable and vector valued functionspresentedingraphical,numeric,andsymbolicform.Studentswilllearntograph,differentiate, integrate and solve applied problems involving parametric equations andvector-valuedfunctions.
- Students will formulate theorems about the concept of probability, calculate probabilitiesusingConditionalprobability,RuleoftotalprobabilityandBayes'theorem.Studentswill

explain the concept of a random variable and the probability distributions, define theconceptofarandom variable.

- Studentswillbeabletoderivenumericalmethodsforvariousmathematicaloperationsandtasks,suchasinterpolation,differentiation,integration,thesolutionoflinearandnonlinearequations,andthesolutionofdifferentialequations.Studentswillanalyseandevaluatetheaccuracyof common numerical methods.
- Students will be able to Study of the interaction of forces between solids in mechanicalsystems.Studentswillknowabouttheapplicationofthevectortheoremsofmechanicsandinterpretationoftheir results,Newton'slawsof motionandconservationprinciples.

Course Outcomes:

1stSemester:

CC- 1- T Differential calculus, Integral calculus, Differential Geometry, Differential Equation:

1. Biologist use of differential calculus to determine the exact rate of growth in a bacterial culture of difference model.
2. Differential calculus uses Different variables such as temperature and food source are changed.
3. In electrical Engineering, Integral calculus is used to determine the exact length of power cables needed to connect to substation which are miles away from each other.
4. Describe the various forms of equation of a plane, straight line, Sphere, Cone and Cylinder.
5. Find the angle between planes, Bisector planes, Perpendicular distance from a point to a plane, Image of a line on a plane, Intersection of two lines.
6. Define coplanar lines and illustrate.
7. Compute the angle between a line and a plane, length of perpendicular from a point to a line.
8. Define skew lines, calculate the shortest distance between two skew lines.
9. Find and interpret the gradient curl, divergence for a function at a given point.
10. Interpret line, surface and volume integrals, evaluate integrals by using Green's Theorem, Stokes theorem & Gauss's Theorem
11. Will be able to solve first-order ordinary differential equations.
12. Will be able to find solution of higher order linear differential equations.
13. Will be able to solve systems of linear differential equations.
    Areas of surface integrals, flus through surfaces, and curvature.

CC-2-TComplex Numbers, Inequality, Theory of equation, Linear Transformation, Matrix, Vector space:

Upon successful completion of this course, Students will be able to:

1. Students will know the ways how to developed numbers.
2. Know the representation of complex numbers in Argand Diagram.
3. Know modulus and amplitude, conjugate of complex number.
4. Apply De Moivre's theorem in a number of applications to solve numerical probs.
5. Complex numbers are used in real life application such as electricity and also to signal processing which is use full in cellular technology and wireless technologies, as well as radar and even biology (brain waves).
6. Know the concept of polynomial, Division algorithm, Synthetic Division and their properties.
7. Apply Descartes's Rule of sign, Cardons method (solve cubic equation), Ferrari's method (solve Bi – quadratic equation).
8. Apply the inequality to the problems of maxima and minimum.

2nd Semester:

CC- 3- T Real Analysis Set in R, Sequence of real numbers, Series of real numbers:

After successful completion of this course, Students will be able to:

1. It helps to learn some properties of real numbers such as algebraic & order properties, completeness property etc.
2. It helps to learn geometrical representation of real numbers.
3. To get an idea of countable set & uncountable set, boundedness of a set, different type of points in set such as limit point, isolated point, interior & exterior point and its application in higher mathematics.
4. To learn arbitrary union of open sets & closed sets.
5. Recognize bounded, convergent, divergent, Cauchy and monotone sequences and to calculate their limit superior, limit inferior and the limit point of a bounded sequence.
6. It helps to draw graphs of some algebraic and transcendental functions.
7. Understand how a sequence of rational numbers converge to a irrational number & how a sequence of irrational numbers converge to a rational number.
8. It helps to find the value of sum of convergent sequences.
9. It helps to verify the series is convergent or divergent.
10. Recognize absolutely convergent & conditionally convergent series.
11. It helps to learn rearrangement of terms of series, to calculate compound interest as geometric sequence.

CC-4-T Differential Equations & Vector Calculus:

1.Express the existence-uniqueness theorem of differential equations, to solve first-order ordinary differential equations & solve exact differential equation.

2. Convert separable and homogeneous equations to exact differential equations by integrating factors.

3. Explain the concept of differential equation.

4. Solve first-order ordinary differential equation.

5.Find solution of higher order linear differential equations.

6.Solve the systems of linear differential equations.

3rd Semester:

CC-5-T Theory of Real function and introduction to Metric Space:

Upon successful completion of this course, Students will be able to:

1. Understand many properties of the real line R and learntodefinesequenceintermsoffunctionsfromRtosubsetof R.
2. Recognizebounded,convergent,divergent,Cauchyandmonotonicsequencesandtocalculatetheirlimitsuperior,limitinferior,andthelimitofaboundedsequence.
3. Enumerate the limits of functions, infinite limits andlimit at infinity
4. Demonstrate, describe, and recognize ways in whichlimitdo not exit.
5. Evaluateonesidedlimitanddescriberelationshipbetweenlimits and one-sidedlimits.
6. Develop solutions for tangent and area problems usingtheconcepts of limits, derivatives.
7. Draw graphs of algebraic and transcendental functionsconsidering limits continuity and differentiability at apoint.
8. Articulatetherelationshipbetweenderivativesandintegralsusingthefundamentaltheorems of calculus.
9. Predict in various cases, like where the speed in a givencurve was maximum without differentiation by Rolle'stheorem.
10. Understand about the basic idea about metric,
11. Explain the examples of various metric space.
12. Demonstrate the open ball, closed ball, interior point, limit point of a metric space.
13. Check the continuity, compactness, connectedness of a metric space.

CC-6-T Group Theory -I:

1. To develop and conduct continuing education programs for Mathematics graduates with a view to update their fundamental knowledge base and problem-solving capabilities in the various areas of Mathematics.

2. Enable students to enhance mathematical skills and understand the fundamental concepts of pure and applied mathematics.

3. To inculcate the curiosity for mathematics in students and to prepare them for future research.

4. Develop, design and implement research projects competently and independently.

5. Identify and define emerging problems related to one's area of interest.

6. Apply the knowledge of mathematical concepts in interdisciplinary fields.

7. Upon completion of the program, students will be able to demonstrate critical understanding at an advanced level with up-to-date knowledge in research methodology of his/her field of interests.

8. Students will be completely prepared to take up PhD and continue his/her research.

9. Qualify Competitive Exams like NET/GATE/SET/GRE etc

CC-7-T Numerical Methods:

1. Numerical analysis deals with the methods for finding the solutions to scientific and engineering problems.
2. The aim of numerical analysis is to provide efficient methods for obtaining numerical answers to the problems which starts some initial data and then computes after some intermediate steps, the final results are obtained.
3. Approximations and errors are an integral part of human life.
4. They are everywhere and unavoidable. we cannot use numerical methods and ignore the existence of errors. Errors come in a variety of forms and sizes.
5. Know to rounding off error.
6. Significant figures and significant errors
7. Absolute, relative and percentage errors.
8. Define basic concepts of operators Δ ,∇ ,E
9. Find the difference of polynomial
10. Solve the problems using Newton forward and Newton backward formula
11. Derive Gauss's formula and Stirling formula using newton forward formula and Newton backward formula.
12. Find maxima and minima for differential difference equation
13. Derive Simpson's 1/3 ,3/8 rules using trapezoidal rule
14. Find the solution of the first order and second order equation with constant coefficient
15. Find the summation of series finite difference techniques
16. Find the solution of ordinary differential equation of first by Euler, Taylor and Runge –Kutta methods.

SEC 1 Logic Set:

After taking the course, the student should be able to:

1. Construct proofs of basics set theoretic identities involving unions, intersections, and cartesian products.
2. Formulate the negation, converse and contrapositive of a quantified implication, both linguistically and its symbolic form.
3. Demonstrate an understanding of the concept of a counterexample and be able to provide appropriate instances.
4. Provide written proofs of statements involving elementary divisibility properties of the integers.
5. Demonstrate knowledge of abstract functions and relations, including being able to state precise definition of basic concept.
6. Demonstrate an understanding of the principle of Mathematical Induction.

7. Demonstrate knowledge of the elementary theory of cardinality, including examoles and applications.

4th Semester:

CC-8-T Riemann Integration ans Series of Functions:

1. Improper Integrals are very common in probability andstatistics.
2. TheLaplacetransform,theFouriertransformand manyspecialfunctionslikeBetaandGammaaredefinedusingimproperintegrals,whichappearinalotofproblemsand computations.
3. Bythehelpofuniformconvergencestudentscanconcludeeasilycompactness,connectednesof a set.
4. Develop the capacity to integrate, while understanding the examples of Riemann integrable functions.
5. Students can demonstrate their ability to graphically or analytically analyze integrability conditions, the sequence of functions, series of functions and their nature by presentations.

CC-9-T Multivariate Calculus:

Students will be able to:

1. Calculate Maxima and minima, LaGrange multiplier, directionalderivatives, levelsets.
2. Any of the operations of vector calculus includinggradient, divergence, andcurl.
3. Multivariatecalculuscanbeappliedtoanalyzedeterministicsystemsthathavemultipledegreesoffreedom.
4. It is used in many fields of natural and social scienceand engineering to model and study high dimensionalsystemsthat exhibitdeterministic behavior.

CC-10-T Ring Theory and Linear Algebra:

After completing the course, students should be able to:

1. Assess properties implied by the definition of rings, factor rings, prime and maximal ideals,
2. Analyze and demonstrate example of ideals and quotient rings,
3. Use the concept of isomorphism and homomorphism for rings,
4. Use the definition and properties of linear transformation and matrices of linear transformations and change the basis, including kernel, range and isomorphism.

GE-4 Partial Differential Equations and applications:

Upon completion of this course, students should be able to:

1. Be familiar with the modelling assumptions and derivations that lead to PDEs,
2. Recognize the majors' classifications of PDEs and the qualitative differences between the classes of equations.
3. Be competent in solving linear PDEs using classical solution methods.
4. Students will demonstrate their ability to graphically or analytically the solution of Cauchy problem, characteristic for PDEs and solution of heat equations.

SEC-2 Graph Theory:

After completion this course Students should be able to:

1. Define the basic concept of graphs, directed graphs and weighted graphs.
2. Defines a graph, identifying edges and vertices and also find the degree of vertex.
3. Express and prove handshaking lemma.
4. Define the properties of bipartite graphs, particularly in trees,
5. Expresses and prove Cayley Theorem,
6. Explain the Warshall algorithm, Dijkstra's algorithm,
7. Solve the Travelling salesman's problem,
8. Represent a graph by a matrix.

5th Semester:

CC-11-T Partial Differential equations and its applications:

Upon completion of this course, students should be able to:

1. Be familiar with the modelling assumptions and derivations that lead to PDEs,
2. Recognize the majors' classifications of PDEs and the qualitative differences between the classes of equations.
3. Be competent in solving linear PDEs using classical solution methods.
4. Students will demonstrate their ability to graphically or analytically the solution of Cauchy problem, characteristic for PDEs and solution of heat equations.

CC-12-T Group Theory II:

This course will enable the students to:

1. Understand the basic concepts of group actions and their applications.
2. Recognize and use the Sylow's theorems to characterize certain finite groups.
3. Understand the absolute concept of Automorphism, inner automorphism, automorphism groups, commutator subgroup and its properties.
4. Answer the basic question from external direct products, fundamental theorem of finite abelian groups.
5. State the Generalized Cayley's theorem, Index theorem.

DSE-1-Linear Programming:

Students will have the knowledge and skills to

1. formulate a given simplified description of a suitable real-world problem as a linear

programming model in general, standard and canonical forms.

2. sketch a graphical representation of a two-dimensional linear programming model given in general, standard or canonical form.

3. classify a two-dimensional linear programming model by the type of its solution.
4. solve a two-dimensional linear programming problem graphically.

5. use the simplex method to solve small linear programming models by hand, given a basic feasible point.
6. The transportation model can be defined as the determination of only one commodity that is being transported from one destination to various locations.

DSE-2-Probability and Statistics:

Students should be able to:

1. Understand continuous probability density functions in general.
2. Recognize the standard normal probability distribution and apply it appropriately.
3. Recognize central limit theorem problems.
4. Describe hypothesis testing in general and in practice.
5. Conduct and interpret hypothesis tests for two population proportions.
6. Discuss basic ideas of linear regression and correlation.

6^{th} Semester:

CC-13-T Metric Space and Complex Analysis:

This course will enable the students to:

1. Learn basic facts about the cardinality of a set.
2. Understand several standard concepts of metric spaces and their properties like openness, closedness, completeness,
3. Bolzano–Weierstrass property, compactness, and connectedness.
4. Identify the continuity of a function defined on metric spaces and homeomorphisms.

CC-14-T-Ring Theory and Linear Algebra:

This course will enable the students to:

1. To know the fundamental concepts in ring theory such as the concepts of ideals, quotient rings, integral domains, and fields.
2. learn in detail about polynomial rings, fundamental properties of finite field extensions, and classification of finite fields.
3. Ring theory has many applications to the study of geometric objects, to topology and in many cases their links to other branches of algebra are quite well understood.
4. The polynomial ring, Homomorphism, Ideal, Integral Domain all are very important for higher study and interview.

DSE-3- Mechanics:

This course will enable the students to:

1. To understand the D'alemberts principle and simple applications.
2. To study the concept of Equations of motion and the equivalent one-dimensional problem.
3. To understand the Kepler problem and inverse square law of force.

DSE-4 -Mathematical Modelling:

Students will be able to:

1. Apply mathematical concepts, including calculus, linear algebra, differential equation to analyse specific problems and identify the appropriate mathematics to realize a solution.
2. Use computer programming and statistical analysis skills to efficiently model systems
3. Recognize the connections between mathematics and other disciplines and understand hoe mathematical ideas are embedded in other contexts.
4. Represent real world systems from science and technology in a mathematical framework.
5. Employ appropriate methods to analyse , solve and evaluate the performance of mathematical models.